Weatherwood
Insulation Data Book
for
Architects

INSULATION DIVISION

CHICAGO MILL AND LUMBER CORPORATION
111 West Washington Street
CHICAGO, ILLINOIS

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WEATHERWOOD: A STRUCTURAL INSULATING BOARD

Manufactured by

CHICAGO MILL AND LUMBER CORPORATION

111 West Washington Street
CHICAGO, ILL.

Weatherwood

INSULATES AGAINST UNFRIENDLY WEATHER

THE COMPANY—ITS RESPONSIBILITY

Products

(1) Weatherwood Insulating Board, ½ in. and 1 in. thick, 4 ft. wide by 8, 9, 10 and 12 ft. long.

(2) Weatherwood Insulating Lath, ½ in. and 1 in. thick, 18x48-in. units with exclusive tongue and groove matched longitudinal edges.

(3) Weatherwood Roof Deck Insulation, ½ in. to 3 in. thick in multiples of ½ in., 2 ft. wide by 5 ft. long.

The Company—Its Experience

Weatherwood is manufactured by the Chicago Mill and Lumber Corporation which has been continuously in business since 1881—a half century of successful accomplishment. The Corporation has long been a producer of lumber and wood products, and has acquired, together with its associated companies, a thorough knowledge of wood and fiber products. The research and engineering staff for many years has studied from every angle the production of materials kindred to insulating board and the cumulative result of this experience is—Weatherwood.

The Company enjoys an extremely satisfactory financial position, and with its associated companies represents a capital investment of approximately $62,000,000, with an annual business in excess of $30,000,000.

The Chicago Mill and Lumber Corporation owns and operates extensive tracts of southern hardwood in Louisiana, Arkansas, Mississippi and North Carolina and is in a position to produce a practically limitless and perpetual quantity of Weatherwood.

Responsibility

Our rating, the highest given in Bradstreet's and R. G. Dun's, is over $1,000,000—first grade of credit.

Manufacturing Facilities

Weatherwood is manufactured in a specially constructed plant with the most modern equipment for the constant control of uniformity in process and product. Expanding production has been provided for in the construction of the plant, assuring an output equal to all demands. The plant is centrally located at Greenville, Miss., in the heart of the Company's southern hardwood tracts, with unexcelled shipping facilities.

Personnel and Service

The Insulation Division of the Chicago Mill and Lumber Corporation is under the management of some of the most capable and best known men in the insulating material industry. Its Research Department is engaged in constant study and experiment to promote insulation improvements.

To its Technical Department may be submitted all problems of application and decoration for insulation, structural, sound deadening or acoustical uses.

How Weatherwood Is Marketed

Weatherwood is marketed nationally, through the better Retail Lumber Dealers who maintain local stocks of all types of Weatherwood.

The Weather Vane Trade Mark

The Weathercock weather vane is the trade-mark of Weatherwood and "the symbol of insulation efficiency." Through our dealers, we will furnish an attractive, practical weather vane in the shape of our Weathercock trade-mark to install on the roof of each building in which Weatherwood has been used in a proper and representative way. This unusually attractive weather vane carries no advertisement.

(A) WEATHERWOOD—MANUFACTURING PROCESS

(A1) General

Weatherwood is an insulating board designed and manufactured for use in all types of structures as an insulation against heat loss and sound transmission.

(A2) Ideal Insulating Structure

Weatherwood is the only insulating board fabricated from hardwood.

The insulating efficiency of any material is largely dependent on the number and size of its confined structural air cells—the greater the number and the smaller the size of the individual cells the greater the efficiency. It is a well-known fact that hardwood fibers are tiny, *closed-end cells.* Hardwood fibers are not sap ducts, but are clustered around the duct areas. Softwood fibers, on the other hand, are mostly continuous tubes or ducts through which the tree elevates its sap.

The microscopic, confined air cells of the individual hardwood fibers, combined with the multitude of small

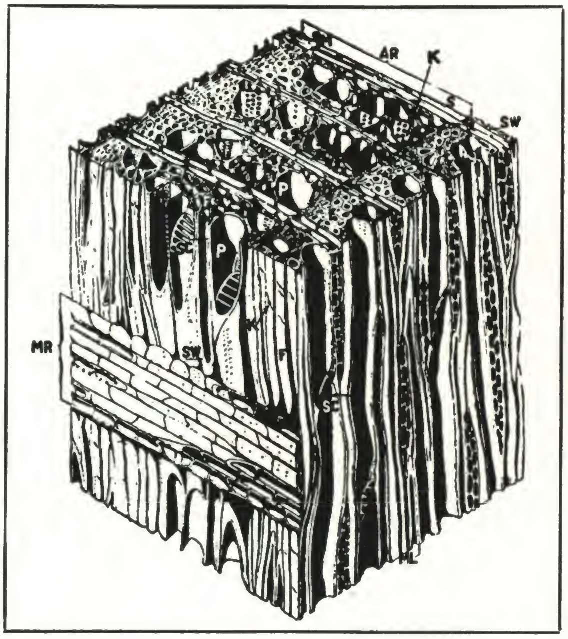
Continued on next page

air cells created between the fibers when these are felted or fabricated in Weatherwood, results in an ideal insulating structure of great efficiency.

(A3) Details of Process

(A3a) Raw Stock—Weatherwood is made largely from the waste from certain species of Southern hardwoods. This includes miscellaneous trimmings from sawmills, as well as trimmings and cuttings in the logging operations which are too small for lumber utilization. This material represents the strongest, toughest part of the trees so far as the fiber is concerned.

(A3b) Fiber Reduction Process—All of the trimmings and logwood arriving at the insulation mill are first passed through barkers which completely remove the unsuitable bark. The remaining clean wood is then delivered to the fiber-reducing equipment which grinds it into the various types of fiber constituting the finished board. It is the particular mixture of fibers, individually and in bundles, that makes possible the felting of the entire mass into a strong, homogeneous board.



Section of Hardwood

This section is enlarged approximately 9½ times showing "F" the closed-end fiber. "AR" is the annular ring made up of "S" spring wood and "SW" summer wood. "MR" shows a transverse medullary ray. "P" is a sap duct formed by the clustered, surrounding fibers "F."

This cut is shown through the courtesy of The Forest Products Laboratory

(A3c) Weatherproofing and Preservative Treatment — Prior to the felting of the fiber into the sheets of Weatherwood, the "stock" is treated with a waterproofing solution, which is uniformly precipitated on each individual fiber of the entire mass. The weatherproofing of a board of this character is accomplished by the formation of a film coating over each fiber which seals the fiber and offers a high surface tension which further protects it from moisture. The waterproofing treatment is consummated with the setting of the size in the drying process (see (A3e)).

The weatherproofing agent also acts as a sterilizing and preservative treatment for the wood fibers.

(A3d) Felting Process—After the various types of fiber have been prepared and the mass reduced to the proper consistency by the addition of clean water, the mixture or "stock" passes on to an improved type of felting machine, where the fibers are felted into the finished boards, leaving the felting machine in a very wet condition.

This process felts the board, full ½ in. thick, in one homogeneous mass instead of combining several layers; thus the board, free of lamination, is not prone to split and is extremely durable in handling and use.

(A3e) Drying Process—The wet sheet of Weatherwood, now fabricated, passes slowly through a dry kiln of the air circulation type. Here, the rapid circulation of dry, warm air removes the excess moisture from the board and at the same time so sets the weatherproofing and preservative that moisture has very little, if any, effect on the finished product.

(A3f) Cutting—As the board comes from the dryer, it is cut to the size requirements of the various products and, passing along diverse lines, is assembled, finished and prepared for shipment.

(B) PHYSICAL CHARACTERISTICS

(B1) Low Thermal Conductivity

The thermal conductivity of Weatherwood has been established by various nationally known testing laboratories. The average conductivity established is .32 B.t.u.'s per hour, per sq. ft., per degree F., per inch thickness. The following test conducted by G. F. Gebhardt, (J. C. Peebles, Testing Engineer) at the Laboratories of Armour Institute of Technology, is typical.

HEAT CONDUCTIVITY OF WEATHERWOOD INSULATING BOARD—FLAT PLATE METHOD

Thickness, in.	Density, lbs. cu. ft.	Heat conductivity, B.t.u.'s per hour	
		1 in. thick	0.502 in. thick
0.502	15.2	0.32	0.64

(B2) Size (Area)

The standard board is 4 ft. wide by 8, 9, 10 or 12 ft. long. Weatherwood Insulating Lath is 18 in. by 48 in. Weatherwood Roof Insulation is 2 ft. by 5 ft.

(B3) Thickness

The Weatherwood boards are fabricated *full ½ in. thick.* All of the various products are marketed in this thickness and in *1-in. thickness* as well.

The 1-in. thick Weatherwood is made up of two thicknesses of the ½-in. stock, rigidly secured together by means of metal staples. This method combines the two ½-in. thick boards permanently into a practical unit *full 1 in. thick.*

See particularly (L3a) page 14 describing in detail the method of manufacturing Stapled Roof Deck Insulation units up to 3-in. thickness.

(B4) Weight

Weatherwood weighs 650 lb. per 1000 sq. ft. of half inch material; inch thickness weighs twice as much, etc.

Continued on next page

(B5) Resistance to Moisture

In the process of manufacture, the complete fiber content is treated to resist absorption of moisture (see (A3c) page 2). Laboratory tests show that the board has an extremely low absorption factor and practically no capillarity.

The insulating efficiency of any material is immediately reduced if it absorbs and holds moisture, due to the fact that water is an excellent heat conductor. Weatherwood under normal building installations may be considered practically moistureproof.

The following tests conducted by G. F. Gebhardt, (J. C. Peebles, Testing Engineer) at the Laboratories of Armour Institute of Technology, are typical.

Water Absorption Test

In making this test two samples of the board measuring 12x12 in. by approximately ½ in. in thickness were used. These samples were placed in a horizontal position in a large vessel containing water, so that the upper surface of the boards was exactly 1 in. below the surface of the water. Each sample was supported on two ½-in. brass rods and held down with sufficient weight to keep the sample submerged. Two brass rods were also placed on the upper surface of each test sample to support the above mentioned weight. In this way, practically the entire surface of the test sample was in contact with the water.

In order that the water might be maintained substantially pure during the test fresh water was supplied at one side of the tank and allowed to flow over a weir at the other side. This water was maintained throughout the test at a constant temperature of 62° F. At the expiration of two hours the samples were removed from the water and the surface moisture removed with blotting paper. They were then weighed and the increase in weight expressed as a percentage of the original dry weight. The results are as follows:

WATER ABSORPTION TEST
WEATHERWOOD INSULATING BOARD

Sample	Size, in.	Weight in grams		Increase in weight	
		Before	After	Grams	Per cent
No. 1	12x12x0.54	332.2	373.0	40.8	12.3
No. 2	12x12x0.54	333.6	375.0	41.4	12.4

Capillarity Test

In conducting this test two samples of the board measuring 4x4 in. by approximately ½ in. thick were used. These samples were placed in a desiccator over sulphuric acid for a period of 24 hours. They were then carefully weighed and placed in a closed vessel containing water. Each sample was placed on edge in such a position that it dipped into the water exactly ½ in. The vessel was then sealed airtight and maintained for 24 hours at a temperature of 70° F. The samples were then removed and weighed and the increase in weight converted to volume of water absorbed, expressed in cubic inches.

CAPILLARITY TEST
WEATHERWOOD INSULATING BOARD

Sample	Size, in.	Water absorbed, cu. in.
No. 1	4x4x0.54	0.445
No. 2	4x4x0.54	0.438

(B6) Structural Strength

The hardwood fibers of which Weatherwood is composed are tough and resilient. Tests on Weatherwood used as sheathing prove that when properly applied, the ½-in. thick board is over twice as strong (so far as bracing against distortion) as standard 13/16-in. thick matched lumber sheathing applied horizontally in the customary manner. Weatherwood also possesses distinct advantages over diagonal sheathing, in that it is not prone to shrinkage or expansion after application, which tends to throw strains into the framework and is much more economical to apply.

Weatherwood has a tensile strength of over 300 lb. per sq. in., and a modulus of rupture of over 400 lb. per sq. in., fiber stress, bending.

(B7) Plaster Bond

Authentic tests show that to rupture the bond between gypsum plaster and Weatherwood Lath requires over 1350 lb. per sq. ft. Even then, the rupture occurs in the board itself and not at the bond surface. The strength of this plaster bond is more than twice that of wood lath and plaster, which experience has proven entirely adequate.

The following test conducted by Robert W. Hunt Company, Engineers, Chicago, is typical:

Three samples, approximately 6 in. square, were plastered with wood fiber plaster and after curing for seven days were secured by asphalt to wooden blocks on each side of the specimen. The wooden blocks were then secured in the testing machine and in attempting to pull them apart, tension was generated on the specimens tending to pull the plaster away from the insulating board, with the results below.

Failure in each case was through the Weatherwood close to the asphalt by which it was secured to the wooden block.

PLASTER BOND
WEATHERWOOD INSULATING LATH

Specimen No.	1	2	3
Size, in...........	6.00x6.05	5.98x5.95	5.98x6.00
Area, sq. ft.......	.2521	.2471	.2492
Maximum load, lb.	345	235	310
Maximum load, lb. per sq. ft.......	1369	951	1255

(B8) Fire Resistance

Weatherwood is slow-burning. Due to the fact that there are no open joints to permit inflow of air, Weatherwood forms a barrier against fire travel.

(B9) Sterility

Made only of clean, sterilized hardwood fibers it is odorless under all conditions. Its weatherproofing chemical treatment during the manufacturing process (see (A3c) page 2), makes it distinctly distasteful to rodents and insects.

(B10) Durability

The hardwood fibers, from which Weatherwood is fabricated, are the toughest and most resilient in the tree growth (see (A3a) page 2), in addition to which all the fibers are treated with a preservative (see (A3c) page 2).

Continued on next page

(B11) Uniformity

Adequate laboratory control and mill inspection assure absolute uniformity in density, structural strength and appearance. Handling facilities and packing methods eliminate damage under normal shipping conditions.

(B12) Non-compressibility—Resilience

When laid over roof decks under standard roofing materials, it is sufficiently firm to prevent injurious denting or cutting of the roofing under normal use. Weatherwood will not compress under furring strips. When compressed under heavy concentrated loads it resumes its original shape after the load is removed.

(B13) Joints

Due to the size of the boards (4 ft. wide by 8, 9, 10 and 12 ft. long) and the method of installation, the unbroken continuity, essential in the solution of insulation problems, is easily maintained. The exclusive Weatherwood Lath tongue and groove, long-side joint maintains similar continuity where these units (18x48 in.) are used.

(B14) Appearance

One surface is finished in a uniform semirough texture and the other in a smooth screen surface. The color is an attractive deep cream.

(B15) Installation

The board is light in weight and in all of the various convenient sizes it is easy to handle and install at low labor costs. It is cut and nailed like lumber.

(B16) Cost

Conservation of waste materials, quantity production and national distribution through established trade channels assure a reasonable cost absorbed in fuel savings in from four to five heating seasons.

(C) USES

(C1) General—Weatherwood, a structural insulating board made in two commercial thicknesses (full ½ in. and full 1 in.), is designed, as set forth in (B) "Physical Characteristics," pages 2, 3 and 4 to fulfill every building insulation need.

The main purpose of all building insulation is to prevent heat loss through the exterior walls and roofs in cold weather and to exclude the heat from the sun's rays in warm weather—justified not only by the economies of fuel conservation but as well by increased comfort reflected in beneficial effects on health.

When properly installed, Weatherwood is an excellent insulation against sound transmission.

Below are briefly outlined the various uses and applications of Weatherwood, each subsequently treated in detail.

(C2) As Sheathing and Roof Boarding—Under wood siding, stucco, masonry veneer, shingles or slate, etc.

(C3) As Roof Insulation—Over wood, concrete, steel or tile roof decks to be covered with a roofing material.

(C4) As Insulating Lath—To receive interior plaster.

(C5) As Interior Finish (without Plaster)—Either in its natural finish or stained or painted. It is an excellent base for plastic paints and may be used as a base for wall paper.

(C6) As Interior Lining for Sound Absorption—To provide proper acoustical conditions for halls, gymnasiums, churches, schools, etc.

(C7) As Exterior Finish—Painted, it has many uses as an exterior exposed finish in the lighter, less permanent constructions where cost is a prime factor.

(C8) As Added Insulation—Added to the usual constructions purely for its insulating value as follows:

(a) Over exterior wood sheathing covered by additional exterior finish.

(b) Under or over wood roof sheathing covered with shingles or other roofing materials.

(c) Over interior wood studs, joists or other framework with an additional plaster base furred out or placed immediately over it.

(d) Between rough and finished floors.

(e) Over wood, concrete, steel or tile roof decks to be covered with a roofing material.

(C9) As Insulation for Masonry Walls—Applied over furring strips, as insulating lath, as interior finish or as insulation only.

(C10) As a Sound Deadener—In partitions and floor to prevent the transmission of sound from one room to those adjoining.

(D) IMPORTANCE OF GOOD CONSTRUCTION

Preliminary Specification Data

(D1) Introduction

Weatherwood Structural Insulation requires no special construction features for successful application. Experience has shown, however, that so frequently are the basic principles of good construction violated, it is important to stress here the salient points; and particularly so, since the building construction is customarily provided for in other divisions of the specification.

We recommend that the details for good construction as approved by the building code committee of the U. S. Department of Commerce and the National Lumber Manufacturers Association be adhered to. Good construction does not add appreciably to the cost.

In no place in the building construction is faulty construction more apparent than in the resulting cracks in the interior plastering. That the lath and plaster is not always responsible for cracking of plastered surfaces is indicated by the following quotation from the National Building Code Committee report.

"Following are some of the common causes which result in cracked plaster:

(1) Inadequate or faulty footing under bearing posts.
(2) Girders too small or too few bearing posts.
(3) Joists of insufficient size.
(4) Joists under partition not doubled.
(5) Improper framing over wide openings.
(6) Uneven settlement due to shrinkage of wood frame improperly designed.
(7) Settlement of wall footing and foundation.
(8) Separation of partitions from walls.
(9) Failure to conform to good plastering standards."

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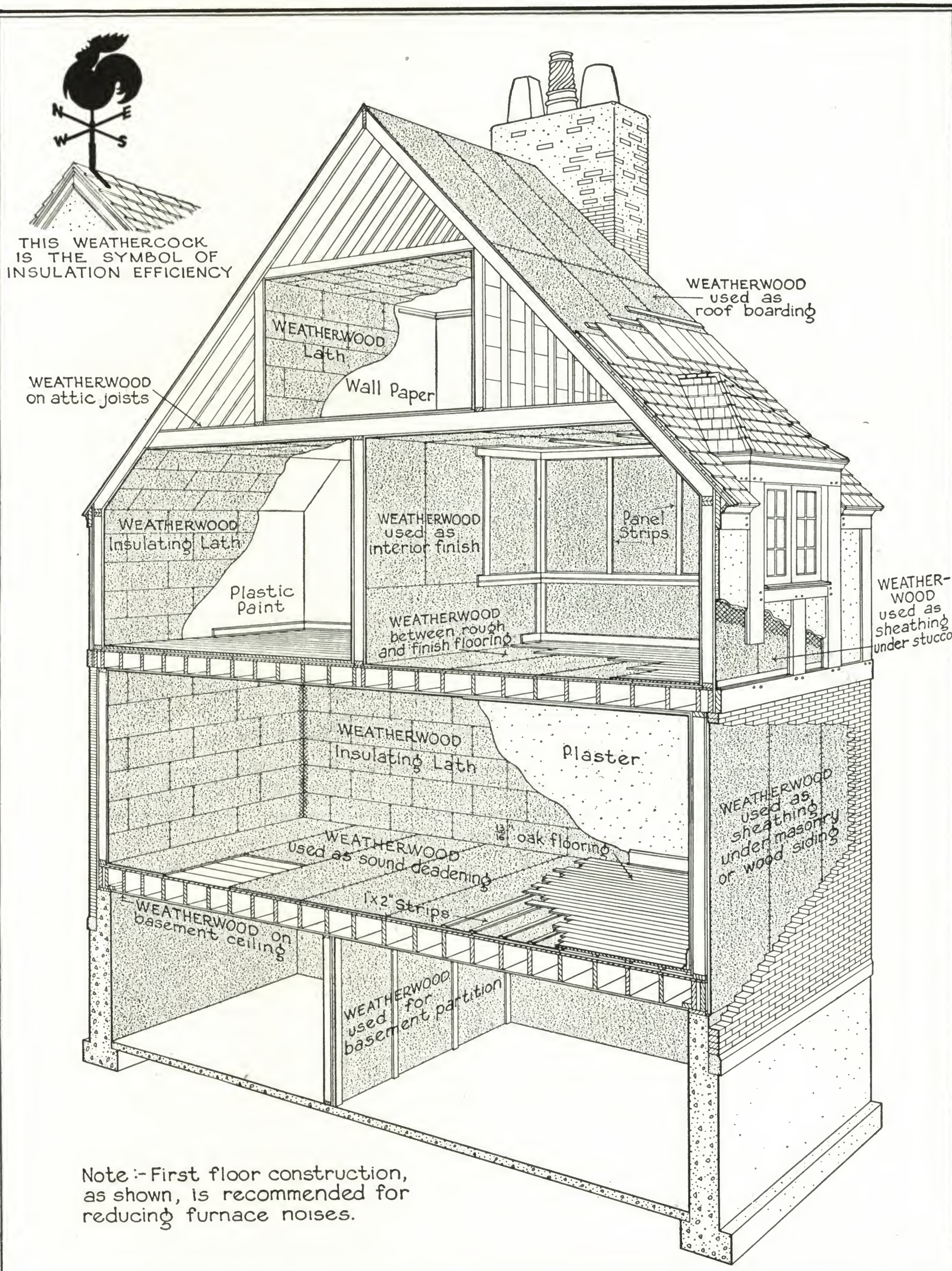

GENERAL ADAPTABILITY OF WEATHERWOOD

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WORKING STRESSES—Joists, Planks, Beams and Stringers—Continuously Dry
(Pounds per Square Inch)
Recommended by Forest Products Laboratory, United States Forest Service, for Grades Complying with the Minimum Basic Structural Provisions of American Lumber Standards

Species	American standard grade	Extreme fiber in bending	Maximum horizontal shear	Compression perpendicular to grain	Modulus of elasticity
Cedar:					
Alaska........	Select	1,100	90	250	1,200,000
	Common	880	72		
Northern and southern white.	Select	750	70	175	800,000
	Common	600	56		
Port Orford...	Select	1,100	90	250	1,200,000
	Common	880	72		
Western red...	Select	900	80	200	1,000,000
	Common	720	64		
Cypress:					
Southern......	Select	1,300	100	350	1,200,000
	Common	1,040	80		
Douglas fir:					
Coast type....	Dense select	1,750	105	380	1,600,000
	Select	1,600	90	345	
	Dense common	1,400	103	380	
	Common	1,200	72	325	
Rocky Mountain type......	Select	1,100	85	275	1,200,000
	Common	880	68		
Fir:					
Balsam.......	Select	900	70	150	1,000,000
	Common	720	56		
Golden, noble, silver, white...	Select	1,100	70	300	1,100,000
	Common	880	56		
Hemlock:					
Eastern.......	Select	1,100	70	300	1,100,000
	Common	880	56		
West Coast....	Select	1,300	75	300	1,400,000
	Common	1,040	60		
Larch:					
Western......	Select	1,200	100	325	1,300,000
	Common	960	80		
Pine:					
California, Idaho and northern white, Pondosa, and sugar.....	Select	900	85	250	1,000,000
	Common	720	68		
Norway.......	Select	1,100	85	300	1,200,000
	Common	880	68		
Southern yellow	Dense select	1,750	128	380	1,600,000
	Dense common	1,400	103	380	
	Common	1,200	88	325	
Redwood	Select	1,200	70	250	1,200,000
	Common	960	56		
Spruce:					
Engelmann....	Select	750	70	175	800,000
	Common	600	56		
Red, white, and Sitka.........	Select	1,100	85	250	1,200,000
	Common	880	68		
Tamarack......	Select	1,200	95	300	1,300,000
	Common	960	76		

(D2) Materials

The species of framing material as well as the proper size should be carefully selected for its specific use. Only thoroughly seasoned lumber should be used.

The warping, twisting, excessive shrinkage and deflection of the framing members are responsible largely for cracks in stucco, masonry veneer and interior plaster whether the sheathing be wood or structural insulation such as Weatherwood, or whether the plaster base be wood, metal, gypsum or Weatherwood Insulating Lath.

While Weatherwood Sheathing is extremely strong (see (B6) page 3), no form of sheathing will prevent distortion due to improperly selected, unseasoned framing members.

The tables on this and the following page are recommended in the selection of framing materials.

(D3) Construction

There are three general types of wood frame construction in common use—namely, "balloon frame," "braced frame" and "Western frame." Lumber shrinks at right angles to the direction of the grain. Since the "balloon frame" construction eliminates to the greatest extent the element of lumber shrinkage it is particularly recommended.

In all three types of framing the corner bracing is a most important feature which should never be omitted. Whether the sheathing be wood, applied horizontally or diagonally, or structural insulation board, such as Weatherwood (see (B6) page 3), the diagonal corner bracing is desirable.

Always include the recommended fire and heat stops in "balloon" and "braced frame" constructions.

To summarize the salient recommended construction features we include the details shown on page 8.

MAXIMUM SPANS FOR CEILING JOISTS AND ATTIC FLOOR JOISTS, Uniformly Loaded

Nominal size of joists, in.	Spacing of of joists, center to center, in.	Maximum allowable lengths between supports (clear span)							
		Limited by deflection of 1/360 of the span. Having determined by reference to the building code or the above table the allowable *modulus of elasticity* in pounds per square inch for the species of timber used, refer to the column below with the corresponding value to determine maximum safe span							
		Ceiling joists				Attic floor joists, live load 20 lb. per sq. ft.			
		E=1,000,000	E=1,200,000	E=1,400,000	E=1,600,000	E=1,000,000	E=1,200,000	E=1,400,000	E=1,600,000
2× 4	12	9′ 4″	10′ 0″	10′ 6″	11′ 0″	6′ 6″	7′ 0″	7′ 4″	7′ 8″
	16	8′ 7″	9′ 2″	9′ 8″	10′ 0″	5′ 11″	6′ 3″	6′ 8″	6′ 11″
	24	7′ 7″	8′ 1″	8′ 6″	8′ 11″	5′ 3″	5′ 7″	5′ 10″	6′ 1″
2× 6	12	14′ 2″	15′ 5″	15′ 10″	16′ 7″	10′ 0″	10′ 9″	11′ 3″	11′ 0″
	16	13′ 3″	14′ 0″	14′ 8″	15′ 4″	9′ 1″	9′ 8″	10′ 2″	10′ 8″
	24	11′ 8″	12′ 5″	13′ 0″	13′ 8″	8′ 1″	8′ 7″	9′ 0″	9′ 7″
2× 8	12	18′ 6″	19′ 8″	20′ 0″	21′ 8″	13′ 4″	14′ 2″	14′ 11″	15′ 7″
	16	17′ 2″	18′ 3″	19′ 3″	20′ 2″	12′ 1″	12′ 10″	13′ 6″	14′ 2″
	24	15′ 4″	16′ 4″	17′ 2″	18′ 0″	10′ 9″	11′ 5″	12′ 0″	12′ 7″
2×10	12	23′ 0″	24′ 5″	25′ 8″	26′ 10″	16′ 9″	17′ 9″	18′ 9″	19′ 7″
	16	21′ 4″	22′ 9″	24′ 0″	25′ 0″	15′ 3″	16′ 2″	17′ 0″	17′ 9″
	24	19′ 3″	20′ 5″	21′ 6″	22′ 6″	13′ 7″	14′ 5″	15′ 2″	15′ 10″
2×12	12	27′ 2″	28′ 11″	30′ 0″		20′ 0″	21′ 4″	22′ 6″	23′ 6″
	16	25′ 6″	27′ 0″	28′ 6″	29′ 9″	18′ 4″	19′ 5″	20′ 6″	21′ 5″
	24	23′ 0″	24′ 5″	25′ 9″	26′ 10″	16′ 4″	17′ 4″	18′ 3″	19′ 1″

Note: The lengths are based on: Maximum allowable deflection of 1/360 of span length. Modulus of elasticity as noted for E.

Ceiling Joists
Dead load: Weight of joists plus plaster ceiling (10 lb. per sq. ft.)
Live load: None.

Attic Floor Joists
Dead load: Weight of joist. Weight of lath and plaster ceiling (10 lb. per sq. ft.). Single thickness of flooring (2.5 lb. per sq. ft.).
Live load: 20 lb. per sq. ft. of floor area.

Continued on next page

(D4) Anchors

Where Weatherwood is used as sheathing and roof boarding, exterior finish or interior finish (see section (C) "Uses" page 4), it is recommended that the framed superstructure be well anchored to the foundation. This is due to the fact that the Weatherwood, an extremely light material, is substituted for the heavier standard wood sheathing, exterior siding, etc., or lath and plaster and the anchors are desirable to compensate for the reduced weight.

(D5) Window and Door Frames

Weatherwood Sheathing and Weatherwood Insulating Lath do not require special window and door frames (see details on page 8). It is strongly recommended that in frame construction the window and door frames, whether of stock or special design, be provided with wide outside blind casings (often omitted) and inside ground casings. Authentic tests show that the air infiltration or leakage around windows where these members are omitted is equal to the air leakage through an unweatherstripped window. To prevent air leakage around wood frames in masonry openings, they should be thoroughly calked with oakum or similar material from the inside.

In the average uninsulated dwelling the estimated heat loss through and about the exterior doors and windows is from 40 to 45 per cent—from 55 to 60 per cent is lost through walls and roofs.

Worthwhile reduction of this heat loss at doors and windows may easily be accomplished by proper design and construction, calking, weatherstrips and storm sash.

Often much of the economy and comfort of well insulated walls is lost through poorly constructed, improperly installed, air leaking windows and doors.

MAXIMUM SPANS FOR FLOOR JOISTS, Uniformly Loaded

(Live load 40 lb. per sq. ft. with plastered ceiling. Live load 50 lb. per sq. ft. with unplastered ceiling)

Nominal size of joists, inches	Spacing of joists center to center, inches	Maximum allowable lengths between supports (clear span): Limited by deflection of 1/360 of the span. Having determined by reference to the building code or the table on page 6 the allowable *modulus of elasticity* in pounds per square inch for the species of timber used, refer to the column below with the corresponding value to determine span				Determined by bending. Having determined by reference to the building code or the table on page 6 the allowable *extreme fiber stress in bending* in pounds per square inch for the species and grade of lumber used, refer to the column below with the corresponding value to determine maximum safe span									
		$E =$ 1,000,000	$E =$ 1,200,000	$E =$ 1,400,000	$E =$ 1,600,000	$f =$ 900	$f =$ 1,000	$f =$ 1,100	$f =$ 1,200	$f =$ 1,300	$f =$ 1,400	$f =$ 1,500	$f =$ 1,600	$f =$ 1,700	$f =$ 1,800
2× 6	12	8′ 6″	9′ 1″	9′ 6″	10′ 0″	9′ 6″	10′ 0″	10′ 5″	10′ 11″	11′ 4″	11′ 10″	12′ 2″	12′ 7″	13′ 0″	13′ 5″
	16	7′ 9″	8′ 3″	8′ 8″	9′ 1″	8′ 3″	8′ 8″	9′ 1″	9′ 6″	9′ 10″	10′ 3″	10′ 8″	11′ 0″	11′ 4″	11′ 7″
	24	6′ 10″	7′ 3″	7′ 7″	8′ 0″	6′ 9″	7′ 1″	7′ 6″	7′ 10″	8′ 1″	8′ 5″	8′ 9″	9′ 0″	9′ 3″	9′ 6″
2× 8	12	11′ 5″	12′ 0″	12′ 8″	13′ 3″	12′ 6″	13′ 2″	13′ 10″	14′ 5″	15′ 0″	15′ 7″	16′ 1″	16′ 8″	17′ 2″	17′ 8″
	16	10′ 5″	11′ 0″	11′ 7″	12′ 1″	10′ 11″	11′ 6″	12′ 0″	12′ 7″	13′ 1″	13′ 8″	14′ 1″	14′ 6″	15′ 0″	15′ 5″
	24	9′ 2″	9′ 8″	10′ 2″	10′ 8″	8′ 11″	9′ 5″	9′ 11″	10′ 4″	10′ 9″	11′ 2″	11′ 7″	12′ 0″	12′ 4″	12′ 8″
2×10	12	14′ 4″	15′ 2″	16′ 0″	16′ 8″	15′ 9″	16′ 7″	17′ 4″	18′ 2″	18′ 11″	19′ 7″	20′ 3″	21′ 0″	21′ 8″	22′ 3″
	16	13′ 1″	13′ 10″	14′ 7″	15′ 3″	13′ 9″	14′ 6″	15′ 2″	15′ 10″	16′ 6″	17′ 1″	17′ 9″	18′ 4″	18′ 10″	19′ 5″
	24	11′ 6″	12′ 2″	12′ 10″	13′ 5″	11′ 4″	11′ 11″	12′ 6″	13′ 1″	13′ 8″	14′ 1″	14′ 7″	15′ 1″	15′ 7″	16′ 0″
2×12	12	17′ 3″	18′ 3″	19′ 3″	20′ 1″	18′ 11″	19′ 11″	20′ 11″	21′ 11″	22′ 8″	23′ 6″	24′ 5″	25′ 2″	26′ 0″	26′ 9″
	16	15′ 9″	16′ 9″	17′ 7″	18′ 5″	16′ 6″	17′ 5″	18′ 3″	19′ 1″	19′ 11″	20′ 7″	21′ 4″	22′ 0″	22′ 9″	23′ 5″
	24	13′ 10″	14′ 9″	15′ 6″	16′ 2″	13′ 8″	14′ 4″	15′ 1″	15′ 9″	16′ 5″	17′ 0″	17′ 7″	18′ 2″	18′ 9″	19′ 4″
2×14	12	20′ 0″	21′ 2″	22′ 6″	23′ 5″	21′ 11″	23′ 2″	24′ 3″	25′ 4″	26′ 4″	27′ 4″	28′ 4″	29′ 4″	30′ 0″	
	16	18′ 4″	19′ 6″	20′ 6″	21′ 5″	19′ 3″	20′ 3″	21′ 3″	22′ 3″	23′ 2″	24′ 0″	24′ 10″	25′ 8″	26′ 6″	27′ 3″
	24	16′ 3″	17′ 3″	18′ 1″	18′ 11″	15′ 11″	16′ 9″	17′ 7″	18′ 5″	19′ 2″	19′ 10″	20′ 7″	21′ 3″	21′ 11″	22′ 6″
3× 6	12	9′ 11″	10′ 6″	11′ 2″	11′ 8″	11′ 10″	12′ 5″	13′ 1″	13′ 8″	14′ 3″	14′ 9″	15′ 3″	15′ 9″	16′ 3″	16′ 9″
	16	9′ 1″	9′ 8″	10′ 2″	10′ 8″	10′ 4″	10′ 11″	11′ 5″	11′ 11″	12′ 5″	12′ 10″	13′ 4″	13′ 9″	14′ 3″	14′ 9″
	24	7′ 11″	8′ 5″	8′ 11″	9′ 4″	8′ 6″	8′ 11″	9′ 5″	9′ 9″	10′ 3″	10′ 8″	11′ 0″	11′ 4″	11′ 9″	12′ 0″
3× 8	12	13′ 1″	13′ 11″	14′ 8″	15′ 4″	15′ 7″	16′ 5″	17′ 3″	18′ 0″	18′ 9″	19′ 5″	20′ 1″	20′ 9″	21′ 5″	22′ 0″
	16	12′ 0″	12′ 9″	13′ 5″	14′ 0″	13′ 8″	14′ 5″	15′ 1″	15′ 9″	16′ 5″	17′ 0″	17′ 8″	18′ 3″	18′ 9″	19′ 4″
	24	10′ 8″	11′ 3″	11′ 10″	12′ 4″	11′ 3″	11′ 10″	12′ 5″	13′ 0″	13′ 7″	14′ 1″	14′ 7″	15′ 0″	15′ 6″	15′ 11″
3×10	12	16′ 5″	17′ 6″	18′ 5″	19′ 3″	19′ 6″	20′ 7″	21′ 7″	22′ 6″	23′ 3″	24′ 4″	25′ 2″	26′ 0″	26′ 9″	27′ 7″
	16	15′ 1″	16′ 1″	16′ 11″	17′ 8″	17′ 2″	18′ 1″	18′ 11″	19′ 9″	20′ 8″	21′ 4″	22′ 2″	22′ 10″	23′ 7″	24′ 3″
	24	13′ 4″	14′ 2″	14′ 11″	15′ 7″	14′ 3″	15′ 0″	15′ 9″	16′ 5″	17′ 1″	17′ 9″	18′ 4″	18′ 11″	19′ 6″	20′ 1″
3×12	12	19′ 9″	20′ 11″	22′ 1″	23′ 1″	23′ 4″	24′ 7″	25′ 9″	26′ 11″	28′ 0″	29′ 1″	30′ 0″			
	16	18′ 2″	19′ 4″	20′ 4″	21′ 3″	20′ 6″	21′ 8″	22′ 9″	23′ 9″	24′ 8″	25′ 8″	26′ 6″	27′ 5″	28′ 3″	29′ 1″
	24	16′ 1″	17′ 1″	18′ 0″	18′ 9″	17′ 1″	18′ 0″	18′ 10″	19′ 9″	20′ 6″	21′ 4″	22′ 1″	22′ 9″	23′ 6″	24′ 2″
3×14	12	23′ 1″	24′ 5″	25′ 9″	26′ 11″	27′ 0″	28′ 6″	30′ 0″							
	16	21′ 3″	22′ 6″	23′ 9″	24′ 10″	23′ 11″	25′ 2″	26′ 5″	27′ 7″	28′ 9″	29′ 9″	30′ 0″			
	24	18′ 9″	20′ 0″	21′ 0″	22′ 1″	19′ 11″	21′ 0″	22′ 0″	23′ 0″	23′ 11″	24′ 10″	25′ 9″	26′ 7″	27′ 5″	28′ 2″

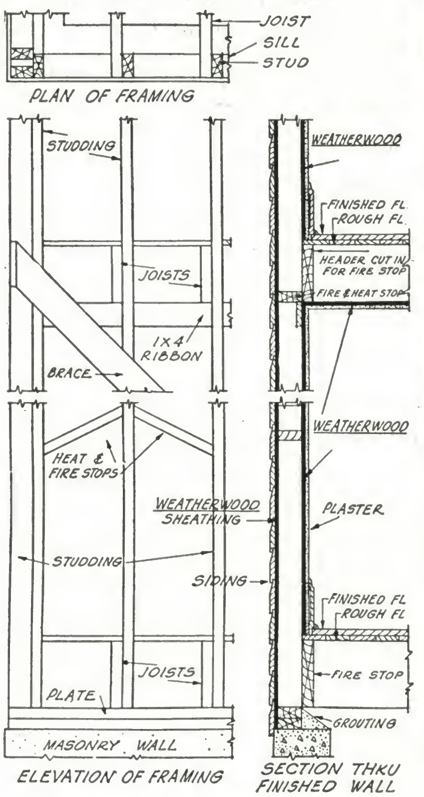
Note: When limited by deflection, the lengths are based on: Maximum allowable deflection of 1/360 of span length. Modulus of elasticity as noted for E. When determined by bending strength on the piece: Allowable stress in extreme fiber in bending as noted for f.

Dead load: Weight of joist. Weight of lath and plaster ceiling (10 lb. per sq. ft.). Double thickness of flooring (5 lb. per sq. ft.). Live load: 40 lb. per sq. ft. of floor area with plastered ceiling, or 50 lb. per sq. ft. with ceiling unplastered.

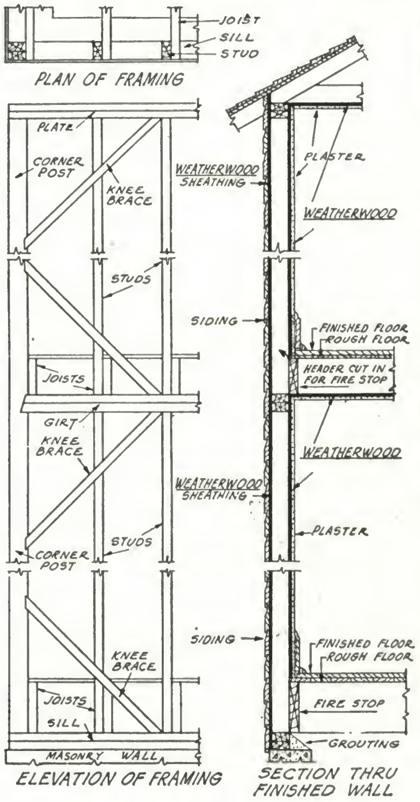
CROSS BRIDGING FOR FLOOR AND CEILING JOISTS

Number of rows	1	2	3
Span	From 6′ 0″ to 10′ 0″	From 10′ 0″ to 20′ 0″	Over 20′ 0″

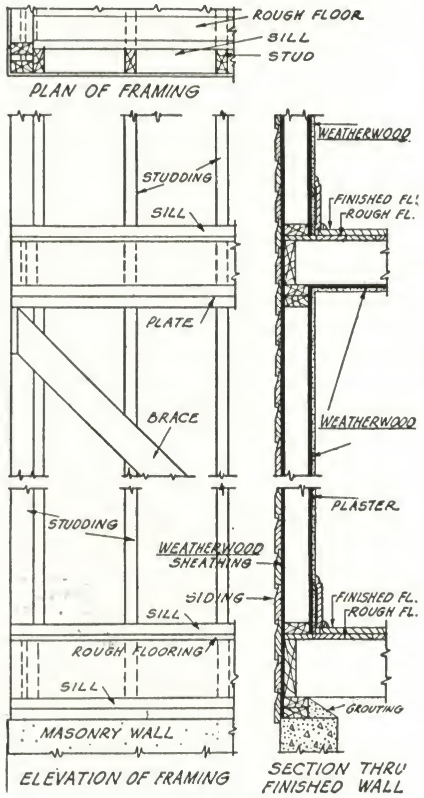
Continued on next page



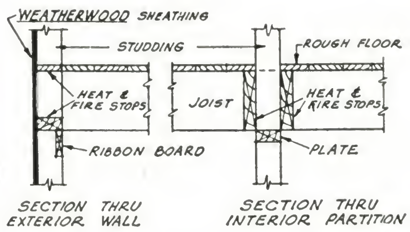
BALLOON FRAME



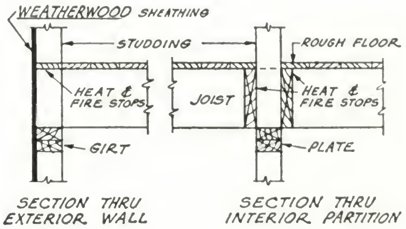
BRACED FRAME



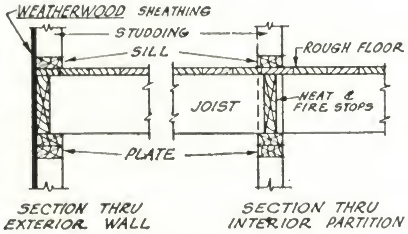
WESTERN FRAME



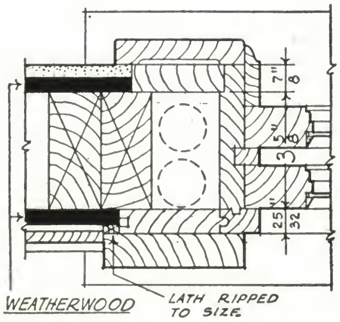
BALLOON FRAME
At Second Floor



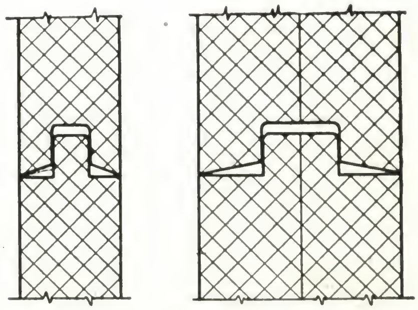
BRACED FRAME
At Second Floor



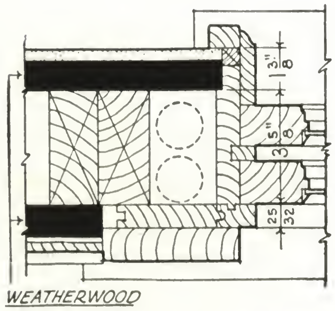
WESTERN FRAME
At Second Floor



STANDARD FRAME
½-in. Weatherwood Lath
½-in. Weatherwood Sheathing



EXCLUSIVE WEATHER-WOOD LATH JOINT
(Longitudinal) F. S. D.



STANDARD FRAME
1-in. Weatherwood Lath
1-in. Weatherwood Sheathing

RECOMMENDED CONSTRUCTION DETAILS

Continued on next page

(E) EFFECTIVE INSULATION THICKNESS AND LOCATION

(E1) Heat Flow

Loss of heat occurs through the heat flow from a substance of high temperature to one of lower temperature. Unless some barrier, such as insulation which definitely resists heat transmission, is interposed between the two elements of different temperatures, the heat flow is rapid until the temperatures equalize.

The insulating efficiency of a material varies directly in proportion to its thickness—thus, twice the thickness, twice the efficiency and conversely, one-half the thickness, one-half the efficiency. This must be taken into consideration in comparing two materials even if they have the same thermal conductivity on the usual 1-in. thickness.

(E2) Roofs

As set forth in (D5) page 7, from 55 to 60 per cent of the heat loss in uninsulated dwellings occurs through the exterior walls and roofs. Of this loss, the greatest proportion is through the roof or top story ceiling, due to the fact that heated air rises and that the roof represents the greatest single area.

Again, in summer the sun's rays fall more directly and with the greatest intensity on the roof, in consequence of which the top story of the uninsulated house is a source of great discomfort during hot weather.

To be effective, a *minimum* of 1-in. thickness of insulation added to the usual standard construction should be installed in the roof or top story ceiling depending on whether there is an attic or whether the attic space is used for living quarters.

(E3) Exterior Walls

While a lesser proportion of heat loss occurs through the exterior walls as compared with roofs, this loss is sufficient to require a *minimum* of ½ in. thickness of insulation (such as Weatherwood Insulating Lath) added to the usual standard frame, wood sheathed construction to provide any definite economy in fuel consumption. See particularly (E4).

The infiltration of air through masonry walls has been definitely established and has now become a factor in heating design. Due to this fact, it is quite as essential that masonry walls be insulated as frame walls. At least ½-in. thick insulation is desirable. Weatherwood Lath applied to furring strips is an economical method.

(E4) Weatherwood as Sheathing and Roof Boarding

When an insulating material is substituted for some other material, such as Weatherwood Sheathing for wood sheathing, no great insulation benefits accrue unless a sufficient thickness of the insulating material is used.

Weatherwood has a thermal conductivity of .32 B.t.u.'s per hour, per sq. ft., per inch thickness, or .64 B.t.u.'s per ½-inch thickness (see (B1) page 2). Stated in terms of heat resistance, half-inch Weatherwood has a resistance of 1.56 degrees (the reciprocal of its conductivity). Ordinary sheathing lumber has a thermal conductivity of .80 B.t.u.'s per sq. ft., per inch thickness or per $\frac{13}{16}$-in. thickness (as ordinarily used), a thermal conductivity of .98 B.t.u.'s per sq. ft., per degree F., per hour and a resistance of 1.02 degrees. In other words, Weatherwood as a sheathing is approximately 55% more effective in the ½-in. thickness than the standard $\frac{13}{16}$-in. wood sheathing.

Despite this fact, and even though there is no insulating board with higher efficiency than Weatherwood, it should be recognized that used alone as sheathing without additional insulation on the interior, such as Weatherwood Insulating Lath, the ½-in. thickness of Weatherwood Sheathing is not sufficient to produce a truly economical wall from a heat loss standpoint. The same considerations apply where Weatherwood is substituted for roof boarding.

Therefore, wherever Weatherwood insulating board is substituted for wood sheathing on walls, and additional insulation is not included on the interior, always use the 1-in. thick Weatherwood.

Where Weatherwood is substituted for roof boarding always use the 1-in. thickness and add at least a ½-in. thickness on the interior primarily as insulation (see (C8) page 4), as an interior finish (see (C5) page 4) or as insulating lath (see (C4) page 4).

(E5) Insulating the Interior

The effectiveness and fuel economy of interior insulation is quite universally overlooked.

It is a well established fact that it is fuel economy to maintain the same temperature in the home both day and night. More fuel is consumed in raising the temperature of a cold house in the morning than is consumed in maintaining the uniform temperature because of the inefficiency of intermittent firing.

It is also a fact that the average person sleeps in a cold bedroom. The radiator is turned off and the window is opened, which virtually during this 8-hour period (one-third of the heating day) converts large areas of the second story into unheated space similar to an unheated attic. The heat loss from the first story through the first story ceiling or second story floor almost compares with the heat loss through the uninsulated top floor ceiling or roof (see (E2) page 9).

If the first story floor over a cold basement, and the first story ceiling (second story floor) are insulated and the partitions between heated halls, bathrooms, dressing rooms and bedrooms are likewise insulated, the greatest fuel economies are possible and greater comfort is assured.

A simple method of accomplishing these desirable features is the use throughout the dwelling of Weatherwood Insulating Lath on all interior partitions and ceilings. In floor construction the use of 1-in. Weatherwood lath or the ½-in. lath on the ceiling with the addition of ½-in. insulation elsewhere in the construction is recommended.

This same insulation which makes it possible to create a cold area as a unit without heat loss in the rest of the house, also adds a great comfort in sound insulation as well. An appreciably less amount of sound will be transmitted from one floor to the next and from one room to those adjoining.

 Continued on next page

(F) WEATHERWOOD AS SHEATHING AND ROOF BOARDING

(F1) Use

(F1a) Walls—Under wood siding, shingles, stucco or masonry veneer.

(F1b) Roofs—Under shingles, slate, tile or similar rigid roof units which may be laid over wood furring strips.

(F2) Sizes

Full ½ in. and 1 in. thick by 4 ft. wide by 8, 9, 10 or 12 ft. long.

(F3) Advantages

(F3a) Low Thermal Conductivity—It is an excellent insulator when used in the proper thickness. (See (B1) page 2 and (E4) page 9.)

(F3b) Strength—One-half inch thick, it is approximately twice as strong (bracing against distortion) as horizontal wood sheathing. (See (B6) page 3.)

(F3c) Moistureproof—Chemically treated, it is highly moisture and decay resistive. It requires no waterproof paper over it for protection. (See (B5) page 3.)

(F3d) No Open Joints—The large boards join only over framing members. Weatherwood provides a continuous, unbroken, uniform surface which, without the aid of waterproof building paper, successfully prevents air infiltration.

(F3e) Expansion or Contraction—Weatherwood under all conditions remains as originally applied. It does not expand or contract appreciably.

(F4) SPECIFICATIONS

Note: *Notes are explanatory or advisory only and should not be included in the specifications.*

Note: *Select and include only those clauses which apply to the particular work. Words in bracketed italics are selective.*

(F4a) Work Included

Note: *Here list and locate definitely the wall and roof areas to be covered. If both ½-in. and 1-in. thickness are used, list separately and the respective locations or areas covered.*

Note: *For selection of thickness see division (E) page 9 and particularly (E4).*

(F4b) Material

(Sheathing) (and) (roof boarding) shall be Weatherwood as made by Chicago Mill and Lumber Corporation, 111 West Washington Street, Chicago. Boards shall be full *(½ in.) (and) (1 in.)* thick *(as above designated)*, 4 ft. wide by 8, 9, 10 or 12 ft. long as best adapted.

(F4c) Application

(F4c1) General—Continuity of insulation is imperative. Apply Weatherwood with the length parallel with the framing members. Where possible boards shall be of sufficient length to completely span between sills and plates or other structural members. Where end joints are necessary these shall only be made centered over 2x4-in. headers cut in between framing members. Side joints shall center over framing members.

(F4c2) Spacing—Weatherwood boards shall be spaced ⅛ in. apart at all edges. Bring the Weatherwood in close contact with window and door frames and trim.

(F4c3) Nails—

(a) Use 6d common nails for ½-in. thick Weatherwood.
(b) Use 8d common nails for 1-in. thick Weatherwood.

Note: *Large headed nails are unnecessary.*

(F4c4) Nailing—At all edges, space nails 3 in. apart on centers and ½ in. from the edge. On intermediate framing members, space nails 6 in. apart on centers. First nail Weatherwood to intermediate studs and then nail the edges.

(F5) SUPPLEMENTARY PROVISIONS

Note: *Provide for the following in other specification divisions.*

Note: *Weatherwood is not a nailing base.*

(F5a) Construction

Follow the recommendations of the Building Code Committee of the U. S. Department of Commerce and the National Lumber Manufacturers Association. (See division (D) pages 4, 6, 7 and 8.)

(F5b) Wood Siding

All joints shall butt over the center of a stud.

(F5c) Furring Strips

Provide 1x2-in. furring strips properly spaced over Weatherwood to take shingles, slate, tile and similar wall and roof covering. Nails shall be sufficiently long to pass through the furring and Weatherwood and penetrate the framing members at least 1 in.

(F5d) Stucco Base

Stucco must be reinforced with self-furring galvanized wire or expanded metal exterior stucco lath secured to studs with nails sufficiently long to pass through the Weatherwood and penetrate the stud at least 1 in.

(F5e) Masonry Veneer Ties

Provide masonry ties at each stud spaced 16 in. apart vertically. Nails shall be sufficiently long to pass through the Weatherwood and penetrate the stud at least 1 in.

(F5f) Frame Furring, etc.

Provide in accordance with the details window and door frame furring strips to compensate for the thickness of Weatherwood.

Note: *We advocate wide outside blind stops in frame construction. If, however, these are omitted, provide that the inside of the outside casings be lined with beveled strips of Weatherwood. See particularly (D5) page 7 and details on page 8.*

(G) WEATHERWOOD INSULATING LATH

(G1) Use

As an insulating plaster base.

(G2) Size

Full ½ in. and full 1 in. thick by 18x48 in. Half-inch thickness wrapped 12 pieces to the package, 72 sq. ft. One-inch thickness wrapped 6 pieces to the package, 36 sq. ft. Weight, 650 lb. per 1000 sq ft., ½ in. thick.

(G3) Advantages

(G3a) Low Thermal Conductivity—It is an excellent insulator when used in the proper thickness. (See (B1) page 2 and (E) page 9, particularly (E4)).

(G3b) The Exclusive Weatherwood Lath Joint—It has always been known that a continuous surface over which plaster might be applied would provide the best possible base. It is, however, impracticable to do this and at the same time eliminate the tendency of such a surface to expand and contract excessively causing buckling.

Previous plaster bases have always left horizontal joints of greater or less width into which the plaster was forced. As the units of such a plaster base dry out and shrink, these joints open up pulling away from the plaster which worked into the joints leaving a weak and fragile plaster joint to withstand all strains and vibrations.

Continued on next page

The tongue and groove Weatherwood Lath joint (see details on page 8) is an *exclusive* Weatherwood feature and alone in its ability to form a tight, strong joint along the horizontal or long edge (spanning the space between framing members) into which plaster cannot be forced. It is so designed that when the wet plaster is troweled over the board, and the slight normal expansion takes place, the beveled profile of the joint permits this expansion to take place by the compression of the fibers at the joint. As the plaster dries, the resilient Weatherwood fibers gradually resume their original position and since they cannot contract to a condition smaller than the original one, there is no opening of joints along these edges. Practically a homogeneous surface is therefore provided as a plaster base, resulting in the elimination of strains at the joints which would tend to crack the plaster.

The tongue and groove joints also eliminate the springing of the board out of its true plane at these unsupported joints when the scratch and brown coats of plaster are being troweled on. This often occurred with earlier forms of lath boards tending to develop hair line cracks through the set and partially dry scratch coat when the brown coat is being applied and before the set plaster thickness is sufficient to withstand the strain.

(G3c) Strong Plaster Bond—Weatherwood provides an especially strong bond between the base and plaster. (See (B7) page 3.)

(G3d) Strength—While not of primary importance, the strength of bracing against distortion when applied to frame construction is an advantage, especially when applied to interior partitions. (See (B6) page 3.)

(G3e) Moistureproof—Moisture cannot pass through Weatherwood Lathe (see (B5) page 3). This characteristic of Weatherwood protects the frame from the moisture of the plaster, which passes into the interior of the building to be carried away by adequate ventilation.

Since the plaster thickness is reduced to a uniform ½ in., less moisture must be driven off during the plastering operation than is the case with open-mesh types of lath which require a much thicker body of plaster.

(G3f) No Lath or Joint Marks—The exclusive Weatherwood Lath tight tongue and groove joint eliminates the so-called lath or joint marks appearing on the plaster surface due to condensation of moisture and collection of dirt along the open joints of the plaster base and which require frequent cleaning and redecoration.

(G3g) Easily Handled—The convenient size, 18x48 in., provides an easily handled unit, rapidly erected. Can be carried into any space a man can work. Is easily scored and cut with a lathing hatchet where necessary to fill out at angles, corners, etc.

(G4) SPECIFICATIONS

Note: *Notes are explanatory or advisory only and should not be included in the specifications.*

Note: *Select and include only those clauses which apply to the particular work. Words in bracketed italics are selective.*

(G4a) Work Included

Note: *Here list and locate definitely the wall and ceiling areas to be covered. If both ½-in. and 1-in. thickness are used list separately and the respective locations or areas covered.*

Note: *For selection of thickness see division (E) page 9 and particularly (E4) and (E5).*

(G4b) Material

Plaster base shall be Weatherwood Insulating Lath as made by Chicago Mill and Lumber Corporation, 111 West Washington Street, Chicago. Units shall be full *(½ in.) (and) (1 in.) thick (as designated above)*, 18 in. wide by 48 in. long.

(G4c) Application

(G4c1) General—Do not moisten lath before application. Apply Weatherwood Lath, rough or textured side exposed and tongue up, with the length at right angles to the framing *(or furring)* members. End joints shall center over framing members. Stagger end joints in successive courses on all walls and ceilings; likewise stagger end joints at juncture of walls and ceilings.

(G4c2) Spacing—Tongue and groove joints shall be brought tight in moderate contact. Units shall be spaced ⅛ in. apart at ends.

(G4c3) Nails—

(a) Use 4d common, blued or box nails, for ½-in. thick Weatherwood Lath.

(b) Use 6d common, blued or box nails, for 1-in. thick Weatherwood Lath.

Note: *Large headed nails are unnecessary.*

(G4c4) Nailing—Space nails 5½ in. apart on centers set ½ in. from the edges. First nail to intermediate framing *(or furring)* members and then at ends. Secure long edges at angles of walls and ceilings, spacing nails 5½ in. on centers and not more than ½ in. from the edge.

(G4c5) Prevention of Condensation—In cold weather apply Weatherwood to exterior studs *(furring) (rafters)*, etc. before temporary heat is applied.

Note: *Because Weatherwood Lath does not permit passage of moisture, heating before lining the exterior cold walls, etc., results in a condensation of moisture from the warm, moist air on the inside of the sheathing and framing members. This originally forms as frost, which melts and must be absorbed gradually by the sheathing and frame, since it cannot pass the Weatherwood barrier to be carried off by the air. Weatherwood applied before heat insulates the warm, moist air from the cold exterior walls and eliminates this possibility of condensation.*

(G5) SUPPLEMENTARY PROVISIONS

Note: *Provide for the following in other specification divisions.*

(G5a) Construction

Follow the recommendations of the Building Code Committee of the U. S. Department of Commerce and the National Lumber Manufacturers Association. See Division (D) pages 4, 6, 7 and 8.

(G5b) Furring

Fur all exterior masonry walls to receive Weatherwood with *(1x2 in.) (specify)* furring strips, accurately shimmed to a true, level plane, set 16 in. on centers. Substantially secured to the masonry.

(G5c) Grounds

Furnish and erect, substantially secured to framing members through the Weatherwood Lath, full ⅜-in. grounds on exterior frame walls and full ½-in. grounds elsewhere.

Note: *Full ½-in. thickness of plaster should be used over Weatherwood Lath. Where stock window and door frames are used they provide for ⅞-in. thickness for lath and plaster, therefore on exterior frame walls, which are usually of less area due to window and door openings, a ⅜-in. thickness may be used. If special frames are detailed, provide for full ½-in. thickness of plaster over the lath.*

(G5d) Plastering

(G5d1) Caution—Do not wet Weatherwood Lath before applying plaster.

(G5d2) Cornerite—Apply metal lath "cornerite" strips over Weatherwood Lath at all re-entrant angles and all corners not protected with corner beads.

(G5d3) Plaster—Use gypsum cement or gypsum wood fiber plasters.

(G5d4) Thickness—Full ⅜ in. thick on exterior frame wall, elsewhere full ½ in. thick, flush with grounds.

Note: *See (G5b) above.*

(G5d5) Application—Apply in three (3) coats in accordance with the plaster manufacturer's specification. Surfaces shall be rodded to a true plane. All corners and angles shall be plumb and true. Wherever necessary and particularly on ceilings, provide plaster screeds to insure an even and uniform plaster thickness.

Note: *The maintaining of a uniform and sufficient plaster thickness over a fibrous or board plaster base such as Weatherwood, and especially on ceilings, cannot be too strongly stressed if permanent, satisfactory results are to be expected. Too frequently a weak, thin plaster coat, inadequate to withstand the usual strains of building settlement, shrinkage and vibration, results in plaster cracks which react on even the best of plaster bases.*

(G5d6) Ventilation—Provide adequate ventilation for the proper drying of the plaster work.

Note: *Due to the moistureproof characteristics of Weatherwood Lath, all moisture emanating from the plastering operation must be carried off by the air coming in contact with the exposed surface. Particular attention to proper ventilation is necessary.*

Continued on next page

(H) WEATHERWOOD AS INTERIOR FINISH

(H1) Introduction

Generally speaking, we realize that Weatherwood as interior finish (without interior plaster) has but limited architectural adaptability. There are, however, many applications, such as acoustical correction, finish for basement, amusement rooms, garages, attic rooms, storerooms, etc., where its good appearance coupled with its value as insulation make it highly desirable. It is particularly practical in alteration work.

It takes stains, paints, plastic paints and wall paper with admirable results. The foundation to which Weatherwood is applied, and the care with which it and the finish is applied is obviously reflected in its final satisfactory appearance.

(H2) Use

As an unplastered interior wall and ceiling finish, in its natural state (unfinished), stained, painted or covered with plastic paint or with wall paper.

Unfinished or finished with stains it has a decided value as an interior lining for sound absorption in halls, gymnasiums, churches, schools, etc. When used for acoustical correction it should not be painted.

(H3) Sizes

(H3a) When Exposed (Natural, Stained or Painted)—Full ½ in. and 1 in. thick (depending on insulation requirements) by 4 ft. wide by 8, 9, 10 and 12 ft. long. Where design dictates, smaller units may be used.

(H3b) Finished with Plastic Paint or Wall Paper—Weatherwood or Weatherwood Insulating Lath, full ½ in. and 1 in. thick (depending on insulation requirements).

(H4) Advantages

(H4a) Low Thermal Conductivity—It is an excellent insulator when used in the proper thickness. (See (B1) page 2 and (E) page 9.)

(H4b) Good Appearance—One side is finished in a uniform semirough, textured finish—the other side smooth. Either side may be selected for exposure. The natural color is an attractive cream-white. Joints may be exposed, finished square or beveled or they may be covered with wood or Weatherwood battens.

(H4c) Strength—It is strong and durable. (See (B3) page 3.)

(H4d) Moistureproof—It is highly moisture resistant. (See (B5) page 3.)

(H4e) Fire Resistance—It is not a fire hazard. (See (B8) page 3.)

(H4f) Continuity—It is a perfect, continuous seal against air infiltration. (See (B10) page 4.)

(H4g) Cleans Easily—In its natural state or stained it is easily cleaned with a stiff brush or with a vacuum cleaner.

(H5) SPECIFICATIONS

Note: *Notes are explanatory or advisory only and should not be included in the specifications.*

Note: *Select and include only those clauses which apply to the particular work. Words in bracketed italics are selective.*

(H5a) Work Included

Note: *Here list and locate definitely the wall and ceiling areas to be covered. If two types of finish—namely (1) exposed with natural stained or painted finish and (2) finished with plastic paint or wall paper or two thicknesses are required, list separately and the respective locations or areas covered.*

(H5b) Material

(H5b1) Wall *(and ceiling)* finish shall be *(Weatherwood Insulation Boards) (and) (Weatherwood Insulating Lath)* as made by Chicago Mill and Lumber Corporation, 111 West Washington Street, Chicago.

Note: *Specify "Weatherwood Insulation Boards" where exposed with natural, stained or painted finish. Specify Weatherwood Insulating Lath where finished with plastic paint or wall paper.*

(H5b2) Size shall be *(½ in.) (and) (1 in.)* thick by 4 ft. by 8, 9, 10 or 12 ft. long or units cut from the board in panels of symmetrically disposed sizes to conform with the detail drawings.

Note: *Use clause above for natural, stained or painted finish. Select the thickness required for insulation value.*

(H5b3) Size shall be *(½ in.) (and) (1 in.)* thick by 18x48 in., standard Weatherwood Insulating Lath.

(H5c) Application

(H5c1) General—

(a) Weatherwood Boards—

Note: *Same as (F4c1) page 10.*

(b) Weatherwood Lath—

Note: *Same as (G4c1) page 11.*

(H5c2) Spacing—

(a) For Weatherwood Boards—

Note: *Same as (F4c2) page 10.*

(b) For Weatherwood Lath—

Note: *Same as (G4c2) page 11.*

(H5c3) Finishing Joints of Weatherwood Boards—

(a) Exposed Joints—Neatly finish the exposed joint edges with sandpaper *(square) (rounded) (beveled)* as detailed.

(b) Battens—Form Weatherwood joint battens of widths detailed with edges neatly sandpapered *(square) (round) (beveled).* Fit battens neatly at all intersections or at points in contact with other trim. Secure battens with finishing nails as specified in (a) (H5c5).

(H5c4) Nails—

(a) For Weatherwood Boards—Use 2-in. finishing nails.

(b) For Weatherwood Lath—

Note: *Same as (G4c3) page 11.*

(H5c5) Nailing—

(a) For Weatherwood Boards—Nails shall be driven at an angle with heads neatly set below the surface.

Note: *Continue same as (G4c4) page 11.*

(b) For Weatherwood Lath—

Note: *Same as (F4c4) page 10.*

(H6) SUPPLEMENTARY SPECIFICATION PROVISIONS—FINISHING, ETC.

Note: *Provide for the following in other specification divisions.*

Note: *Weatherwood is not a nailing base.*

(H6a) Construction

Note: *Same as (F5a) page 10.*

(H6b) Furring

Note: *Same as (G5b) page 11.*

(H6c) Finish

Note: *Weatherwood boards may be left natural, or finished with stain or paint. Weatherwood lath may be finished with plastic paint or wall paper.*

(H6c1) Natural—When a harder surface is desired, colorless sizing, such as water size, may be applied.

(H6c2) Stain—Weatherwood takes water, alcohol or other types of stain admirably, either in single tones, panels or stencil design.

Note: *Where used as acoustical correction, use stain only. Paint fills the pores and materially reduces the acoustical efficiency.*

(H6c3) Paint—Size thoroughly with water, glue or oil size. Apply paint in accordance with the manufacturer's directions.

(H6c4) Plastic Paint—Plastic paints do not provide satisfactory protection from excessive moisture. Where a building is highly humidified at times, the use of plastic paint over Weatherwood is not recommended, since it takes but slight shrinkage strain to form cracks in the thin plastic paint layer.

Continued on next page

In no case is a single coat of plastic paint over Weatherwood recommended. Such a thin coat will not adequately cover all irregularities and joints and it provides no protection against the usual strains of service. Therefore, use two (2) coats of plastic paint on Weatherwood.

Joints should be filled with the joint filler specified by the plastic paint manufacturer and covered with cloth or wire screen tape as specified.

Depending on the type of plastic paint, size may or may not be required. Apply plastic paint in accordance with the manufacturer's directions.

(H6c5) Wall Paper—First line the wall over the Weatherwood Lath with 1½-lb. unsaturated building felt neatly applied with wall paper paste in the same manner as wall paper. The joints should be accurately trimmed to butt. Over the felt apply the wall paper in the customary manner. Careful workmanship will furnish a highly satisfactory finish almost comparable with that of a plastered wall.

(J) WEATHERWOOD AS EXTERIOR FINISH

(J1) Use

While generally speaking of limited architectural adaptability, Weatherwood as exterior finish has many applications, especially when its moistureproof insulation value is considered.

It is particularly adapted to the lighter, less permanent construction where cost is a prime factor, and especially for buildings of but one story, such as small dwellings, garages, summer cottages, portable temporary schools, etc. It is an ideal exterior finish for such temporary construction buildings as offices and tool and material storehouses.

(J2) Sizes

Full ½ in. and 1 in. (depending on insulation requirements) thick by 4 ft. wide by 8, 9, 10 or 12 ft. long.

(J3) Advantages

The advantages as set forth in (F3) page 10 for Weatherwood Sheathing and Roof Boarding apply equally to Weatherwood Exterior Finish.

(J4) Specifications

(J4a) Construction Provisions—Follow the recommendations of the Building Code Committee of the U. S. Department of Commerce and the National Lumber Manufacturers Association. (See division (D) pages 4, 6, 7 and 8.)

(J4b) Application, etc.—The specifications (F4) page 10 for Weatherwood Sheathing apply likewise to Weatherwood Exterior Finish.

(J4c) Painting—Size thoroughly with a dependable water, glue or oil size. Finish with two (2) coats of any good exterior house paint applied in accordance with the manufacturer's directions.

Note: *The painting of Weatherwood surfaces should be done before the application of the joint battens, trim, etc.*

(J4d) Joint Battens, Trim, etc.—Cover all joints between the Weatherwood boards and all edges with wood batten strips or exterior wood trim, secured through the Weatherwood to the framing members.

(K) WEATHERWOOD USED AS ADDED INSULATION

(K1) Use

Note: *See separate division (L) page 14 for Weatherwood Insulation over roof decks of wood, concrete, steel, tile, etc.*

(K1a) Over Exterior Wood Sheathing—Covered by additional exterior finish such as wood siding, shingles, stucco, masonry, veneer, etc.

(K1b) Under or Over Wood Roof Boarding—Covered by shingles or other roofing materials. For rigid roofing units, such as wood shingles, slate, etc., furring strips are recommended if insulation is placed over roof boarding. Generally speaking, if placed under roof boarding directly on the rafters the position closer to the heat source is preferable, and obviously any type of roofing applicable over wood roof boarding may be used.

(K1c) Over the Interior of Framing Members—Over studs, furring, joists, rafters, etc., with plaster base furred over or placed immediately over the Weatherwood.

(K1d) Between Rough and Finished Floors.

(K2) Sizes

Full ½ in. and 1 in. thick by 4 ft. wide by 8, 9, 10 or 12 ft. long.

(K3) Advantages

(K3a) Low Thermal Conductivity—It is an excellent insulator. (See (B1) page 2.)

(K3b) Moistureproof—Chemically treated it is highly moisture and decay resistive, thus permanently of insulation value. (See (B5) page 3.)

(K3c) Continuity—No Open Joints—When properly applied, it provides a continuous unbroken surface which successfully prevents air infiltration. (See (B13) page 4.)

(K3d) Non-compressibility—Retains its firm, non-compressible form when placed under other materials, thus maintaining its original insulating value. (See (B12) page 4.)

(K3e) Rugged Strength—Does not tear or break in application. (See (B6) page 3.)

(K3f) Decreases Fire Hazard—Permits the proper location of the recommended fire stops in standard construction and in itself is not a fire hazard. (See (B8) page 3.)

(K3g) Easy to Install—Light and rigid, its conveniently sized units are easily and economically installed.

(K4) SPECIFICATIONS

Note: *Notes are explanatory or advisory only and should not be included in the specifications.*

Note: *Select and include only those clauses which apply to the particular work. Words in bracketed italics are selective.*

(K4a) Work Included

Note: *Here list and locate definitely the insulation to be installed. If both ½ in. and 1-in. thicknesses are used, list separately and the respective locations or areas covered.*

Note: *For selection of thickness, see division (E) page 9.*

(K4b) Material

Insulation shall be Weatherwood as made by CHICAGO MILL AND LUMBER CORPORATION, 111 West Washington Street, Chicago. Boards shall be full *(½ in.) (and) (1 in.)* thick *(as above designated)*, 4 ft. wide by 8, 9, 10 or 12 ft. long as best adapted.

(K4c) Application

(K4c1) General—Continuity of insulation is imperative. Apply Weatherwood with the length parallel with the framing members, smooth face exposed. Where possible, boards shall be of sufficient length to completely span between sills and plates or other structural members. Where end joints are necessary, these shall only be made centered over 2x4-in. headers cut in between framing members. Side joints shall center over framing members.

(K4c2) Spacing—Weatherwood boards shall be spaced ⅛ in. apart at all edges. Bring the Weatherwood in close contact with window and door frames and trim.

(K4c3) Nails—

(a) Use 6d common nails for ½-in. thick Weatherwood.

(b) Use 8d common nails for 1-in. thick Weatherwood.

Note: *Large headed nails are unnecessary.*

(K4c4) Nailing—Space nails on edges and intermediate framing members 12 in. apart on centers. Nail to intermediate supports first and then nail edges approximately ½ in. from the edge.

Note: *Additional fastening is provided through the securing of the usual covering materials. If advantage of the structural strength of Weatherwood is desirable, nailing should be done in accordance with clause (F4c4) page 10 instead of as above.*

Continued on next page

(K4c5) Prevention of Condensation—
Note: Same as (G4c5) page 11.

(K5) SUPPLEMENTARY PROVISIONS

Note: Provide for the following in other specification divisions.
Note: Weatherwood is not a nailing base.

(K5a) Construction

Note: Same as (F5a) page 10.

(K5b) Furring Strips

Note: Same as (F5c) page 10 unless provision is made for securing the covering with nails sufficiently long to pass through the Weatherwood and penetrate the sheathing or roof boarding beneath. Also same as (G5b) page 10 where required on the inside of masonry walls.

(K5b1) Where Weatherwood is used over rough flooring, provide 1-in. x 2-in. stripping 16 in. over centers to receive nailing of finished flooring.

(K5c) Stucco Base

Note: Same as (F5d) page 10.

(K5d) Masonry Veneer Ties

Note: Same as (F5e) page 10

(K5e) Frame Furring, etc.

Note: Same as (F5f) page 10.

(L) WEATHERWOOD INSULATION OVER ROOF DECKS

(L1) Use

Over wood, concrete, tile, and steel roof decks covered with standard built-up roofing. Prevents heat loss and condensation. Particularly adapted to industrial use.

(L2) Size (Area of Units)

Weatherwood Roof Insulation units for industrial purposes are made 2 ft. wide by 5 ft. long representing the ultimate development of experience with various sizes of units for roof insulation. It weighs approximately 625 lb. per ½-in. thickness, per 1000 sq. ft. This size of the Weatherwood Roof Insulation unit is the correct medium between a unit which is too small or too large for economical and practical application.

Insulation, due to its protection against low roof deck temperatures, reduces the contraction of the deck. This reduced contraction of a roof deck during cold weather is compensated for by a slight yielding of the fibers within each unit—some of this contraction and expansion is also taken up in the joints between the Weatherwood units.

Note: The application of insulating material over a roof deck tends to decrease the amount of contraction and expansion which takes place due to the extremes of temperature. The difference in temperature from one extreme to the other in a roof deck covered with 1 in. of Weatherwood ranges between 40° and 90°—a total variance of only 50°, whereas on an uninsulated deck, the temperature of the deck in extremes of temperature ranges between zero and over 100°, a variance of over 100°. The resulting reduction in expansion and contraction strains is obvious.

(L3) Thicknesses and Weights

Weatherwood Roof Insulation units (2x5 ft.) are made in full ½-in. thickness or any multiple of ½ in. up to full 3-in. thickness. They weigh 60 lb. per square (100 sq. ft.) for ½-in. thick, 130 lb. per square 1 in. thick, 195 lb. per square 1½ in. thick, 260 lb. per square 2 in. thick, 325 lb. per square 2½ in. thick and 390 lb. per square 3 in. thick.

Weatherwood unit thicknesses provide the greatest economy in application, since the correct thickness for the greatest efficiency is applied in one operation—not built up by applying various layers of the ½-in. thickness on the job.

Weatherwood Roof Insulation units are factory fabricated to the various thicknesses in the two methods described below:

(L3a) Stapled Weatherwood—The various thicknesses are provided by stapling layers of ½-in. Weatherwood units (2x5 ft.) together with non-corroding metal clips. These clips are spaced close enough to secure rigidity and permanence. An advantage of stapling lies in the increased heat resistance.

There is a definite resistance to heat flow called contact resistance at the point where two layers of material are placed together due to the two surfaces and the thin film of air between them. Tests at the University of Minnesota by Prof. F. D. Rowley show that in a 2-in. block made by stapling four pieces of ½-in. material together, the total heat resistance of the block is increased slightly over 11% as compared to a solid 2-in. thickness of the same material.

The cross section of the clip is so small that even the most delicate instruments would show no appreciable heat loss by conduction through them from inside to outside surface.

(L3b) Laminated Weatherwood—For special purposes or for those who prefer this type, Weatherwood Roof Insulation units (2x5 ft.) are made as a laminated board, wherein the ½-in. thicknesses are cemented together with a high grade waterproof cement.

This cement is a development of years of research and experience by the Chicago Mill and Lumber Corporation in the manufacture of plywood. Its use provides added moisture sealing at each layer since the cement is even more moisture resistant than the Weatherwood.

The method does not require hydraulic pressure, consequently there is no reduction of thickness or increased density of the Weatherwood Insulation with the resultant lessening of insulating efficiency.

(L4) Advantages

(L4a) Insulating Efficiency—Weatherwood Roof Insulation has a thermal conductivity of .32 B.t.u. per inch thickness per hour, per degree F., temperature difference, per square foot. (See (B1) page 2 for supporting evidence.)

(L4b) Thickness and Size of Units—The thicknesses of Weatherwood Roof Insulation are full ½ in. and multiples thereof up to *full* 3 in. (See (L3) opposite.) This should be borne in mind when making comparisons with other insulating materials. It is obvious that two boards having the same thermal conductivity on an inch basis would be unlike in actual efficiency if one were full ½ in. thick, the other of lesser thickness, or if one becomes compressed in application. (See (L4c) below.)

The unit area (2x5 ft.) of Weatherwood Roof Insulation in the various thicknesses is not only the most practical from an installation economy point of view, but it is an area which experience has proven will best compensate for the expansion and contraction of the deck upon which it is laid. Under the most adverse conditions it prevents wrinkling and buckling of built-up roofings laid over it. (See (L2) and (L3) on this page and (L4h) page 15.)

(L4c) Non-compressibility—Resilience—Weatherwood compresses slightly under heavy pressures, but upon release of pressure immediately returns to its original thickness. This resilience protects against loss of efficiency and makes the covering material more resistant to abrasion and puncturing.

(L4d) Bond—Weatherwood bonded to another substance by use of pitch or asphalt will withstand a pull of over 1200 lb. per sq. ft. This more than provides for the bonding requirements of a roof insulating material.

(L4e) Moisture Resistance—As explained in (A3c) page 2 describing the manufacture of Weatherwood, moisture absorption is extremely low because of the thorough weatherproofing of the individual fibers in making up the board. It is not only unaffected by moisture, but, in addition, has no capillarity, so that even with moisture on the top surface of Weatherwood from leaks in roof covering, or beneath Weatherwood on roof deck from condensation, this moisture will not be drawn into the board (see (B5) page 3 for supporting evidence). This is an important factor in guarding against deterioration of insulating material due to rot or decay.

Continued on next page

(L4f) Tough—Easily Handled—Weatherwood Roof Insulation is the only insulating board fabricated from hardwood. The strong hardwood fibers from which it is produced assure a board of unusual strength, and one that is light and easy to handle. The tough fibrous structure is such that the board is not brittle, having a high tensile strength. It is easily cut and can be adapted to all types of openings, or roof angles. It is uniform in thickness—assured by inspection and approval of each board before packing at the mill. Bundles are substantial and easy to handle on the job.

(L4g) Adapts Itself to Irregularities of Roof Decks—A prime requirement of an insulating material for application over concrete is that it be yielding enough to form itself to the irregularities of the deck and, at the same time be rigid enough to prevent wrinkling and buckling when embedded in hot pitch or asphalt. Weatherwood is midway between the two extremes—pliable enough to follow irregularities in the concrete surface—rigid enough to permit a maximum of economy in handling and application. The size of Weatherwood Roof Insulation units practically eliminates any tendency to bridge over depressions in the surface of the deck and loss of bonding at these points.

(L4h) Absorbs Expansion and Contraction—An insulative material must be capable of absorbing expansion and contraction strains within itself without buckling or wrinkling.

Weatherwood has sufficient rigidity in itself to add considerable bracing strength to the steel deck and some additional resistance to the bending of the steel deck under load. Because of the yielding nature of its fibers, it is capable of absorbing a large amount of contraction within its own structure.

(L4i) Low Coefficient of Expansion—A material which is to be applied over a roof deck must be of an inert nature, that is, it must have a low coefficient of expansion under moisture conditions, so that additional expansion and contraction effects are not added to the roof deck itself. In addition, a material which expands or contracts greatly due to moisture will have a tendency to curl as one side or the other becomes moist. This is ruinous to any material applied over a roof deck. Because of its highly weatherproofed, fibrous structure, there is practically no expansion in Weatherwood. Weatherwood is an inert or "dead" material, which does not tend to curl or buckle because of strain within itself. This characteristic is imparted to Weatherwood in the manufacture of the board because of its completely homogeneous structure, and the nature of its all wood fiber.

(L5) APPLICATION OVER WOOD DECKS SPECIFICATIONS

Note: *Notes are explanatory or advisory only and should not be included in the specifications.*

Note: *Select and include only those clauses which apply to the particular work. Words or clauses in bracketed italics are selective—use only when they apply.*

(L5a) Work Included

Note: *Here list and locate definitely the roof areas to be covered. If more than one thickness is used, list separately and the respective locations or areas covered.*

Note: *For data to assist in the selection of the correct thicknesses required for fuel and radiation savings and the prevention of condensation, see divisions (L9) and (L10) page 21.*

(L5b) Material

Roof insulation shall be Weatherwood as made by Chicago Mill and Lumber Corporation, 111 West Washington Street, Chicago. Insulation shall be *(specify)* thick, *(stapled) (laminated)* boards, 2x5 ft. in area.

(L5c) Application

(L5c1) Condition of Deck—Deck shall be dry, finished smooth, swept clean and all nails driven flush.

(L5c2) Felt—Apply *(one) (two)* layer *(s)* of dry, saturated roofing felt over the roof boards. Lap the felt at least 1½ in. at joints. *(Felt shall extend 6 in. up on walls and all vertical surfaces and shall finally be turned over and mopped to top of insulation.)*

Note: *Felt protects against dripping of pitch or asphalt through deck. Include last bracketed italicized clause only where there is excessive humidity inside the structure. Depending on humidity conditions use one or two layers.*

(L5c3) Laying—Apply the Weatherwood units over the felt, bringing the edges to contact. Break joints between alternate rows. *(Where more than one thickness of insulation is used on a single area, nail the first layer in place only sufficiently to maintain its alignment and lay the second layer directly over the first, breaking all joints.)*

Note: *Include or omit last bracketed italicized clause above as required.*

Lay only as much insulation as can be covered and protected by the finished roof covering in a single day. Where work is stopped, protect the edges of insulation with overlapping mopped strips of roofing felt, leaving the felt strips as a permanent seal.

(L5c4) Nailing—Insulation shall be secured to deck with roofing nails sufficiently long to penetrate through the insulation and provide firm hold in deck. Space nails approximately 12 in. apart on centers and not more than 2 in. from edges of the unit. Carry one row of nails longitudinally through the center of each unit.

(L5c5) Finished Roofing—Finished roofing shall be applied over insulation in accordance with the manufacturer's specification, using at least 35 lb. of *(pitch) (asphalt)* per square under the first layers.

(L6) APPLICATION OVER CONCRETE OR TILE ROOF DECKS—SPECIFICATIONS

Note: *Notes are explanatory or advisory only and should not be included in the specifications.*

Note: *Select and include only those clauses which apply to the particular work. Words or clauses in bracketed italics are selective—use only when they apply.*

(L6a) Work Included

Note: *Here list and locate definitely the roof areas to be covered. If more than one thickness is used, list separately and the respective locations or areas covered.*

Note: *For data to assist in the selection of the correct thicknesses required for fuel and radiation savings and the prevention of condensation see divisions (L9) page 16 and (L10) page 21.*

(L6b) Material

Roof insulation shall be Weatherwood as made by Chicago Mill and Lumber Corporation, 111 West Washington Street, Chicago. Insulation shall be *(specify)* thick, *(stapled) (laminated)* boards, 2x5 ft. in area.

(L6c) Application

(L6c1) Condition of Deck and Insulation—Deck shall be smooth, dry and swept clean. Surfaces of Weatherwood shall be dry.

Note: *Hot pitch or asphalt will not adhere to moist surfaces.*

(L6c2) Felt—Apply *(one) (two)* layer *(s)* of saturated roofing felt over the roof deck, thoroughly stuck in hot *(pitch) (asphalt)*. Felt shall extend 6 in. up on walls and all vertical surfaces and shall finally be turned over and mopped to top of insulation.

Note: *Include this clause where interior of structure is subject to high humidity conditions as in paper, textile mills, etc., or on applications made during winter months where decks do not have opportunity to thoroughly cure and dry out before insulation is applied.*

Continued on next page

(L6c3) Priming—Prime deck thoroughly before mopping of asphalt.

Note: *Include this clause if insulation is laid in asphalt.*

(L6c4) Laying—Mop deck thoroughly with *(composition of hot pitch and tar) (hot asphalt)* using not less than 35 lb. per square. Apply the Weatherwood units while the mopping is still hot. Firmly bed the Weatherwood in the binder over the entire surface, bringing the edges to contact. Break joints between alternate rows. *(Where more than one thickness of insulation is used on a single area. Mop the surface of the first layer and apply the second layer while the binder is still hot, breaking all joints. Press second layer firmly into position.)*

Note: *Include or omit last bracketed italicized clause above as required.*

Lay only as much insulation as can be covered and protected by the finished roof covering in a single day. Where work is stopped, protect the edges of insulation with overlapping mopped strips of roofing felt stuck down to the deck. Leave strips as a permanent seal when work is resumed.

(L6c5) Finished Roofing—Finished roofing shall be applied over insulation in accordance with the manufacturer's specification, using at least 35 lb. of *(pitch) (asphalt)* per square under the first layers.

(L7) APPLICATION OVER STEEL DECKS SPECIFICATIONS

Note: *Notes are explanatory or advisory only and should not be included in the specifications.*

Note: *Select and include only those clauses which apply to the particular work. Words or clauses in bracketed italics are selective—use only when they apply.*

(L7a) Work Included

Note: *Here list and locate definitely the roof areas to be covered. If more than one thickness is used, list separately and the respective locations or areas covered.*

Note: *For data to assist in the selection of the correct thicknesses required for fuel and radiation savings and the prevention of condensation, see divisions (L9) page 16 and (L10) page 21.*

(L7b) Material

Roof insulation shall be Weatherwood as made by Chicago Mill and Lumber Corporation, 111 West Washington St., Chicago. Insulation shall be *(specify)* thick, *(stapled) (laminated)* boards, 2 x5 ft. in area.

(L7c) Application

(L7c1) Condition of Deck and Insulation—Deck shall be smooth, dry and swept clean. Surfaces of Weatherwood shall be dry.

Note: *Hot asphalt will not adhere to moist surfaces.*

(L7c2) Laying—Mop deck thoroughly with hot asphalt using not less than 35 lb. per square.

Note: *Pitch should not be used over steel decks.*

Apply the Weatherwood units while the mopping is still hot. Firmly bed the Weatherwood in the binder over the entire surface, bringing the edges to contact. Break joints between alternate rows. *(Where more than one thickness of insulation is used on a single area. Mop the surface of the first layer and apply the second layer while the binder is still hot, breaking all joints. Press second layer firmly into position.)*

Note: *Include or omit last bracketed italicized clause above as required.*

Lay only as much insulation as can be covered and protected by the finished roof covering in a single day. Where work is stopped, protect the edges of insulation with overlapping mopped strips of roofing felt stuck down to the deck. Leave strips as a permanent seal when work is resumed.

(L7c3) Finished Roofing—Finished roofing shall be applied over insulation in accordance with the manufacturer's specification, using at least 35 lb. of *(pitch) (asphalt)* per square under the first layers.

(L8) APPLICATION UNDER STEEL DECKS

Some steel decks are so designed and assembled as to permit the placing of an insulating board on the under side of the deck to act as interior ceiling finish, as well as for insulating efficiency and the absorption of sound within the structure.

This is accomplished by placing the board into the flanges of the supporting members of the roof deck, wedging it under the stiffening angles.

The chief requirements of an insulating board for this purpose is that it be stiff enough not to sag between supports; moisture resistant enough not to require painting or other protection; a comparatively high sound absorption efficiency; high insulating efficiency; a light color with good light reflection value, combined with attractive surface appearance. All of the requirements are readily met with Weatherwood.

Application details depend upon the design of each particular roof deck. In general, Weatherwood is cut to fit and pieces are of a special size. A clearance of one-quarter inch is to be left at all edges. End joints should come over framing members for sealing purposes. Weatherwood is fastened into position by the wedging together of the steel deck.

Complete specifications adapted to the specific deck construction will be furnished on application.

(L9) DETERMINATION OF HEAT RESISTANCE OF INDUSTRIAL ROOFS

(L9a) General

One of the chief factors in determining the economic efficiency of an industrial roof is its resistance to heat flow. This heat flow is going on through any roof deck when there is a difference in temperature between the interior and exterior surfaces of a building. The rate of heat flow depends upon, first, the design of the roof structure and second, upon the amount of insulation used in combination with the roof deck.

Definite ratings have been established for materials in all types of construction which give the rate of heat flow in British thermal units of heat per square foot of area for each degree of temperature difference and for the thickness of material specified in the rating. These B.t.u. ratings must be transposed into economic units, that is, into the pounds or units of fuel wasted by the flow of heat represented in the B.t.u. rating.

The determination of these unit costs is a simple mathematical computation, but the various factors making up this computation must be selected to suit the conditions met in each particular problem. The following text, tables and charts illustrate the factors involved, show the method of mathematical calculation and by use of the graphical charts, provide a quick and easy method of computing the comparative efficiency of any roof deck.

(L9b) Factors Involved

(L9b1) Conductivity or B.t.u. Ratings—The conductivity of the deck, both insulated and uninsulated, must first be determined. Tables on page 18 give such B.t.u. ratings for all of the common types of roof construction, together with their B.t.u. rating insulated in various degrees. In order to obtain maximum economic efficiency, the heat loss in units of fuel must be determined. The cost of insulating materials is then balanced against the savings made possible by their use.

(L9b2) Area—The square foot area of the roof deck, subject to the loss of heat, must be determined. This is fixed by the design of the structure.

(L9b3) Temperature Difference—The average difference in temperature must be fixed by comparing the average desired inside temperature and the average outside temperature during the heating season. This average outside temperature varies with locality as shown on the table on page 20, which gives these average values for various parts of the United States, for the period from October 1 to May 1 or seven months. If these values are used, figure a heating season of 210 days. Some engineers prefer to figure the actual number of days during which the average outside temperature is lower than the inside temperature. When this is done, an average outside value should be used just covering that period or number of days.

Continued on next page

(L9b4) Fuel—The fuel units consumed by loss of heat through a roof naturally depends upon the amount of heat represented by each fuel unit. A partial list of fuels showing their comparative heat contents follows:

Anthracite coal	11,600 to 13,500 B.t.u. per lb.
Bituminous coal	12,000 to 14,500 B.t.u. per lb.
Distillate oil—32° to 40° Baume	135,000 to 140,000 B.t.u. per gal.
Natural gas	1,131 B.t.u. per cu. ft.
Coal Gas	560 B.t.u. per cu. ft.

(L9b5) Efficiency of Heating Equipment—The efficiency of the fuel burning equipment determines the percentage of the actual heat content of the fuel that is turned into useful heat in the structure. Coal burning equipment will usually range between 50% efficient for residential buildings up to 65% efficient for industrial plants. Oil burning equipment will range between 65% and 75% under like conditions. Gas efficiency is usually figured at about 80%.

(L9c) MATHEMATICAL COMPUTATION FOR FUEL SAVING

In computing mathematically the fuel loss through any roof the procedure is as follows: the conductivity or B.t.u. rating is multiplied by the area of the roof in square feet, by the difference in average inside and outside temperatures during the heating season, by the number of days in the heating season (period covered by average outside temperature value) and finally, by 24 hours to change the B.t.u. hourly rating into day units. The product of this series of multiplications is then divided by the heat contents per unit of the fuel used and by the efficiency of the fuel burning equipment. In the case of coal, to reduce the pounds of fuel to tons, the product is divided by 2000.

A typical determination of coal saving by the use of one inch of Weatherwood follows:

Location: Chicago, Illinois.

Roof deck—5-in. concrete slab covered with built up roofing.

Conductivity uninsulated (from table on page 18)	.532
Conductivity with 1-in. Weatherwood (from table on page 18	.203
Area of roof deck (assumed)	20,000 sq. ft.
Inside temperature (average throughout 24 hrs.)	60° F.
Exterior temperature (average for seven months from table on page 19	36.4° F.
Temperature difference	23.6° F.
Heating season (seven months used for temperature)	210 days
Fuel (coal assumed at)	12,000 B.t.u. per lb.
Boiler efficiency (assumed)	65%

$$\frac{(.532 - .203) \times 20{,}000 \times 23.6 \times 210 \times 24}{12{,}000 \times .65 \times 2000} \ldots\ldots 50.2 \text{ tons}$$

(L9d) RADIATION REQUIREMENTS

(L9d1) General—The amount of radiation saved by the insulation of the roof also enters into the determination of economic efficiency of the roof structure. The factors involved in mathematically computing the radiation saving by insulation are as follows:

L9d2) Conductivity—The conductivity or B.t.u. rating must be determined for the deck, both uninsulated and with the amount of insulation added which is to be considered, as in the case with computations for coal saving.

(L9d3) Temperatures—Interior temperature average during the day and night is not used as in the case of coal saving, but the maximum required temperature during any extended period is the temperature used. Determine the lowest outside temperature from table on page 19 and to this add 15°, as it is only necessary that sufficient radiation be provided to furnish a maximum temperature with an outside temperature of approximately 15° above the lowest. This is because the lowest outside temperature is very unusual and probably exists for only short periods.

(L9d4) Type of Radiation—The type of radiation, that is, steam, vapor or hot water, will determine the B.t.u. rating per square foot for the radiation used. Usual values for these three types of radiation are as follows:

Steam radiation	240 B.t.u. per sq. ft.
Vapor system	200 B.t.u. per sq. ft.
Hot water system	150 B.t.u. per sq. ft.

(L9e) MATHEMATICAL COMPUTATION FOR RADIATION SAVINGS

The difference in temperature between maximum interior temperature desired and a temperature 15° above the lowest recorded outside temperature, should be multiplied by the difference in conductivity of the insulated roof as compared to the uninsulated roof and multiplied again by the roof area. Divide the product of this multiplication by the B.t.u. rating of the type of radiation to be used. A typical illustration of radiation savings by the use of Weatherwood as in the previous problem follows:

Example

Outside low temperature (lowest recorded plus 15°) from table on page 19	–8° F.
Inside maximum desired temperature	65° F.
Temperature difference	73° F.
Type of radiation (steam assumed)	240 B.t.u. per sq. ft.

Take other conditions from analysis of fuel saving (L9c)

$$\frac{73^\circ \times (.532 - .203) \times 20{,}000}{240} = 2001 \text{ sq. ft. of radiation saved.}$$

(L9f) GRAPHIC SOLUTION OF FUEL AND RADIATION SAVINGS

(L9f1) General—Easy and rapid calculation of the savings in coal and radiation on any type of deck and with any amount of insulation may be found without the necessity of mathematically computing such savings by the use of graphic chart on page 20. In using this chart, first determine the factors which influence the solution, just as in the mathematical computations given in (L9c) and (L9e).

(L9f2) Fuel Saving Computation—Having determined these factors turn to the chart and select the point on the conductivity scale representing the conductivity of the uninsulated roof deck as determined from tables on page 18 or calculated. The scale of conductivities is found on the left side of the vertical center line at the top of the chart and ranges from .0 to .9 B.t.u. per hour. From this point pass horizontally to the left to an intersection with the line representing the thickness of Weatherwood to be used. From this intersection pass vertically down to the diagonal line representing the proper temperature difference (average inside and average outside) on the lower half of the chart. From this intersection pass horizontally to the right to an intersection with the diagonal line representing number of days in heating season. From this intersection pass vertically up to an intersection with the line representing the fuel to be used and efficiency of plant. From this intersection pass horizontally to the right to the scale at the right edge of the chart. The readings on this scale give the units of fuel saved over one heating season per thousand square feet of roof area as follows:

Scale reading direct	= tons of coal
Scale reading × 100	= gallons of oil
Scale reading × 10,000	= cu. ft. of gas

In order to determine the total fuel required per thousand square feet of roof area for any deck either insulated or uninsulated, follow exactly the same procedure but start with the proper conductivity on the horizontal scale at the center of the left hand portion of the chart on page 20 and do not use the upper half of that portion of the chart or the Weatherwood curves.

(L9f3) Radiation Savings—In order to determine the savings, start again at the point on the conductivity scale representing conductivity of uninsulated deck and pass horizontally across to the line representing the thickness of Weatherwood. From this intersection, pass vertically down to the diagonal line representing temperature difference between maximum inside and low outside temperatures. From this intersection, pass horizontally to the right to an intersection with one of the three radiation scales at the right edge, either steam, vapor, or hot water. The reading thus established on this scale is the number of square feet saved by use of the insulation for each 1000 sq. ft. of roof.

To determine the total required radiation for any deck, start at the horizontal scale at the center of the page with the conductivity of the deck as it is to be built and by intersecting the temperature difference line and the radiation scale, the reading on this last scale gives the total square feet of radiation required for each 1000 sq. ft. of this roof deck.

Continued on next page

COEFFICIENTS OF TRANSMISSION (U)

Various Types of Flat Roof Decks Covered with Built-up Roofing

Note: These coefficients are expressed in B.t.u. per hour per square foot per 1 degree Fahrenheit difference in temperature between the air on the two sides and are based on an outside wind exposure of 15 miles per hour.

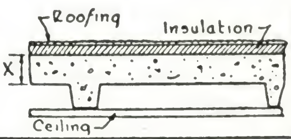
Note: These tables are reproduced from The American Society of Heating and Ventilating Engineers Guide, by special permission.

FLAT ROOFS - METAL LATH AND PLASTER CEILINGS ‡

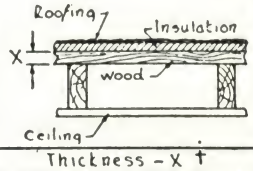
The values of U in this Table are based on the following Internal Conductivities (C) which are expressed in B.t.u. per Hr. per Sq.Ft. per 1°F

Roofing	1.325	per 1"
Concrete	8.30	per 1"
Gypsum (15% Wood fiber)	2.30	per 1"
Wood (Yellow Pine or Fir)	1.00	per 1"
Fiber Insulation (Board form)	0.33	per 1"
Felts & Quilts (So/t)	0.27	per 1"
Cork board	0.30	per 1"
Plaster (Gypsum)	2.32	per 1"
Cellular Gypsum (24*)	0.77	per 1"

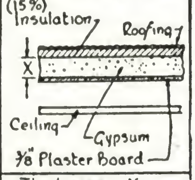
Concrete Roofs



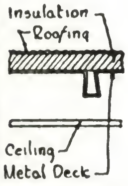
Wood Roofs



Poured Gypsum Containing Wood Fiber (15%)



Flat Metal Roofs



Roof No.	Thickness of Insulation	Kind of Insulation	Concrete Roofs — Thickness - X: 1 5/8" a	2" b	3" c	4" d	5" e	6" f	Wood Roofs — Thickness - X †: 1" g	1½" h	2" i	3" j	4" k	Poured Gypsum — Thickness - X: 3" l	4" m	Flat Metal Roofs n
227	0"	No Insulation	0.304	0.300	0.290	0.280	0.271	0.262	0.258	0.227	0.213	0.175	0.149	0.221	0.202	0.324
228	½"	Fiber Insulation (Board form)	0.208	0.206	0.201	0.196	0.192	0.188	0.185	0.169	0.160	0.138	0.121	0.165	0.154	0.217
229	1"		0.158	0.157	0.154	0.152	0.149	0.146	0.145	0.133	0.129	0.114	0.102	0.132	0.125	0.163
230	1½"		0.128	0.127	0.125	0.123	0.121	0.119	0.119	0.112	0.108	0.097	0.089	0.110	0.105	0.131
231	2"		0.107	0.106	0.105	0.104	0.102	0.101	0.101	0.096	0.093	0.085	0.078	0.095	0.091	0.109
232	1"	Cork board	0.151	0.150	0.147	0.145	0.142	0.140	0.138	0.129	0.124	0.110	0.100	0.127	0.120	0.155
233	1½"		0.121	0.120	0.118	0.116	0.115	0.113	0.112	0.106	0.103	0.093	0.085	0.105	0.104	0.123
234	2"		0.100	0.100	0.099	0.098	0.096	0.095	0.095	0.090	0.088	0.081	0.075	0.089	0.086	0.102
235	½"	Soft Felt or Quilt (Not Compressed)	0.194	0.192	0.188	0.184	0.180	0.176	0.174	0.160	0.152	0.132	0.116	0.157	0.147	0.202
236	1"		0.143	0.142	0.139	0.137	0.135	0.133	0.132	0.123	0.118	0.106	0.096	0.121	0.115	0.147
237	2"	Cellular Gypsum	0.170	0.168	0.165	0.162	0.159	0.156	0.154	0.143	0.136	0.120	0.107			

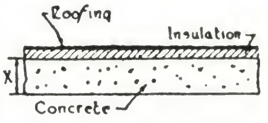
*Precast cement. †Nominal thicknesses specified—actual thicknesses used in computations.
‡The figures in this table may be used with sufficient accuracy for wood lath and plaster ceilings.

FLAT ROOFS - NO PLASTER CEILINGS (UNDERSIDE OF ROOF DECK UNFINISHED)

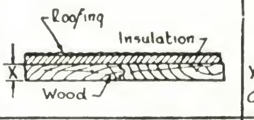
The values of U in this Table are based on the following Internal Conductivities (C) which are expressed in B.t.u. per Hr. per Sq.Ft. per 1°F

Roofing	1.325	per 1"
Concrete	8.30	per 1"
Gypsum (15% wood fiber)	2.30	per 1"
Wood (Yellow Pine or Fir)	1.00	per 1"
Fiber Insulation (Board form)	0.33	per 1"
Felts & Quilts (So/t)	0.27	per 1"
Cork board	0.30	per 1"
Plaster Board	3.04	per 1"
Cellular Gypsum (24*)	0.77	per 1"

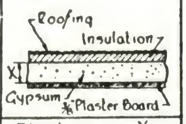
Concrete Roofs



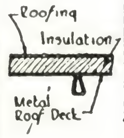
Wood Roofs



Poured Gypsum Containing 15% Wood Fiber



Flat Metal Roofs



Corrugated Iron Roofs

Roof No.	Thickness of Insulation	Kind of Insulation	Concrete Roofs — Thickness - X: 1 5/8"* a	2" b	3" c	4" d	5" e	6" f	Wood Roofs — Thickness - X †: 1" g	1½" h	2" i	3" j	4" k	Poured Gypsum — Thickness - X: 3" l	4" m	Flat Metal Roofs n	Corrugated Iron Roofs o
216	0"	No Insulation	0.680	0.658	0.610	0.568	0.532	0.500	0.485	0.386	0.345	0.256	0.204	0.369	0.318	0.781	1.50 ‡
217	½"	Fiber Insulation (Board form)	0.334	0.330	0.317	0.306	0.295	0.285	0.280	0.243	0.226	0.184	0.156	0.237	0.214	0.358	
218	1"		0.222	0.220	0.214	0.209	0.203	0.199	0.196	0.178	0.168	0.144	0.126	0.174	0.162	0.232	
219	1½"		0.166	0.165	0.162	0.159	0.156	0.153	0.151	0.140	0.134	0.118	0.106	0.138	0.130	0.172	
220	2"		0.133	0.132	0.130	0.128	0.126	0.124	0.123	0.116	0.112	0.100	0.091	0.114	0.109	0.136	
221	1"	Cork board	0.208	0.206	0.201	0.196	0.192	0.188	0.185	0.169	0.160	0.138	0.121	0.165	0.154	0.217	
222	1½"		0.154	0.153	0.151	0.148	0.145	0.143	0.142	0.132	0.126	0.124	0.101	0.130	0.120	0.160	
223	2"		0.123	0.122	0.120	0.119	0.117	0.115	0.114	0.108	0.104	0.095	0.086	0.107	0.102	0.126	
224	½"	Soft Felt or Quilt (Not Compressed)	0.301	0.297	0.286	0.277	0.268	0.260	0.256	0.225	0.210	0.174	0.148	0.219	0.200	0.319	
225	1"		0.193	0.191	0.187	0.183	0.179	0.175	0.174	0.159	0.151	0.131	0.116	0.156	0.146	0.201	
226	2"	Cellular Gypsum	0.246	0.243	0.236	0.229	0.223	0.217	0.214	0.193	0.182	0.154	0.133				

*Precast cement. †Nominal thicknesses specified—actual thicknesses used in computations.
‡No built-up roofing. The value for corrugated iron is obtained by assuming that the surface area is increased 50 per cent.

These tables are based on the use of ½-in. insulating board with rated efficiency of .33 B.t.u. per in. thickness per sq. ft. per hour. The thermal conductivity of Weatherwood is .32 B.t.u., therefore the use of Weatherwood increases these wall efficiencies slightly over the figures given above.

 Continued on next page

CLIMATIC CONDITIONS
COMPILED FROM U. S. WEATHER BUREAU RECORDS

Col. A	Col. B	Col. C	Col. D	Col. E	Col. F
State	City	Average temp., Oct. 1st–May 1st	Lowest temperature	Average wind velocity Dec., Jan., Feb., miles per hr.	Direction of prevailing wind, Dec., Jan., Feb.
Ala.	Mobile	57.7	−1	8.3	N
	Birmingham	53.9	−10	8.6	N
Ariz.	Phoenix	59.5	16	3.9	E
	Flagstaff	34.9	−25	6.7	SW
Ark.	Fort Smith	49.5	−15	8.0	E
	Little Rock	51.6	−12	9.9	NW
Cal.	San Francisco	54.3	29	....	N
	Los Angeles	58.6	28	....	NE
Colo.	Denver	39.3	−29	7.4	S
	Grand Junction	39.2	−16	5.6	SE
Conn.	New Haven	38.0	−14	9.3	N
D.C.	Washington	43.2	−15	7.3	NW
Fla.	Jacksonville	61.9	10	8.2	NE
Ga.	Atlanta	51.4	−8	11.8	NW
	Savannah	58.4	8	8.3	NW
Idaho	Lewiston	42.5	−13	4.7	E
	Pocatello	36.4	−20	9.3	SE
Ill.	Chicago	36.4	−23	17.0	SW
	Springfield	39.9	−24	10.2	NW
Ind.	Indianapolis	40.2	−25	11.8	S
	Evansville	44.1	−15	8.4	S
Iowa	Dubuque	33.9	−32	6.1	NW
	Sioux City	32.1	−35	12.2	NW
Kans.	Concordia	38.9	−25	7.3	N
	Dodge City	40.2	−26	10.4	NW
Ky.	Louisville	45.2	−20	9.3	SW
La.	New Orleans	61.5	7	9.6	N
	Shreveport	56.2	−5	7.7	SE
Me.	Eastport	31.1	−23	13.8	W
	Portland	33.6	−17	10.1	NW
Md.	Baltimore	43.6	−7	7.2	NW
Mass.	Boston	37.6	−13	11.7	W
Mich.	Alpena	29.1	−27	11.3	W
	Detroit	35.4	−24	13.1	SW
	Marquette	27.6	−27	11.4	NW
Minn.	Duluth	25.1	−41	11.1	SW
	Minneapolis	29.6	−33	11.5	NW
Miss.	Vicksburg	56.0	−1	7.6	SE
Mo.	St. Joseph	40.3	−24	9.1	NW
	St. Louis	43.3	−22	11.8	NW
	Springfield	43.0	−29	11.3	SE
Mont.	Billings	34.7	−49	....	W
	Havre	27.7	−57	8.7	SW
Nebr.	Lincoln	37.0	−29	10.9	N
	North Platte	34.6	−35	9.0	W
Nev.	Tonopah	39.6	−7	9.9	SE
	Winnemucca	37.9	−28	9.5	NE
N.H.	Concord	33.4	−35	6.0	NW
N.J.	Atlantic City	41.6	−7	10.6	NW
N.Y.	Albany	35.1	−24	7.9	S
	Buffalo	34.7	−14	17.7	W
	New York	40.3	−6	13.3	NW
N.M.	Santa Fe	38.0	−13	7.3	NE
N.C.	Raleigh	49.7	−2	7.3	SW
	Wilmington	53.1	5	8.9	SW
N.D.	Bismarck	24.5	−45	....	NW
	Devil's Lake	18.9	−44	11.4	W
Ohio	Cleveland	36.9	−17	14.5	SW
	Columbus	39.9	−20	9.3	SW
Okla.	Oklahoma City	48.0	−17	12.0	N
Ore.	Baker	34.1	−20	6.0	SE
	Portland	45.9	−2	6.5	S
Pa.	Philadelphia	41.9	−6	11.0	NW
	Pittsburgh	40.8	−20	13.7	NW
R.I.	Providence	37.6	−9	14.6	NW
S.C.	Charleston	56.9	7	11.0	N
	Columbia	53.7	−2	8.0	NE
S. D.	Huron	28.1	−43	11.5	NW
	Rapid City	32.3	−34	7.5	W
Tenn.	Knoxville	47.0	−16	6.5	SW
	Memphis	50.9	−9	9.6	NW
Texas	El Paso	53.0	−2	10.5	NW
	Fort Worth	54.7	−8	11.0	NW
	San Antonio	60.7	4	8.2	N
Utah	Modena	38.1	−24	8.9	W
	Salt Lake City	40.0	−20	4.9	SE
Vt.	Burlington	29.3	−27	12.9	S
Va.	Norfolk	49.1	2	9.0	N
	Lynchburg	45.2	−7	5.2	NW
	Richmond	47.4	−3	7.4	S
Wash.	Seattle	45.3	3	9.1	SE
	Spokane	37.5	−30	....	SW
W.Va.	Elkins	38.8	−21	4.8	W
	Parkersburg	41.9	−27	6.6	S
Wis.	Green Bay	28.6	−36	12.8	SW
	La Crosse	31.2	−43	5.6	NW
	Milwaukee	33.0	−25	11.7	W
Wyo.	Sheridan	31.0	−45	5.3	NW
	Lander	28.9	−36	3.0	NE

INSIDE TEMPERATURES USUALLY SPECIFIED

Type of building	Deg. Fahr.
Schools—	
Class rooms	68
Assembly rooms	66–68
Gymnasiums	55–65
Toilets and baths	70
Wardrobe and locker rooms	65–68
Kitchens	66
Dining and lunch rooms	65–68
Playrooms	60–65
Natatoriums	75
Theatres—	
Seating space	68–72
Lounge rooms	68
Toilets	68
Hotels—	
Bedrooms and baths	70
Dining rooms	70
Kitchens and laundries	66
Ball rooms	65–68
Toilets and service rooms	68
Hospitals—	
Private rooms	70
Private rooms (surgical)	70–80
Operating rooms	70–95
Wards	68
Kitchens and laundries	66
Toilets	68
Bathrooms	70–80
Homes—	
Where 68° is generally the desirable standard of temperature a guarantee of 70° is customarily exacted.	
Stores	65–68
Public buildings	68–70
Warm air baths	120
Steam baths	110
Factories and machine shops	60–65
Foundries and boiler shops	50–60
Paint shops	80

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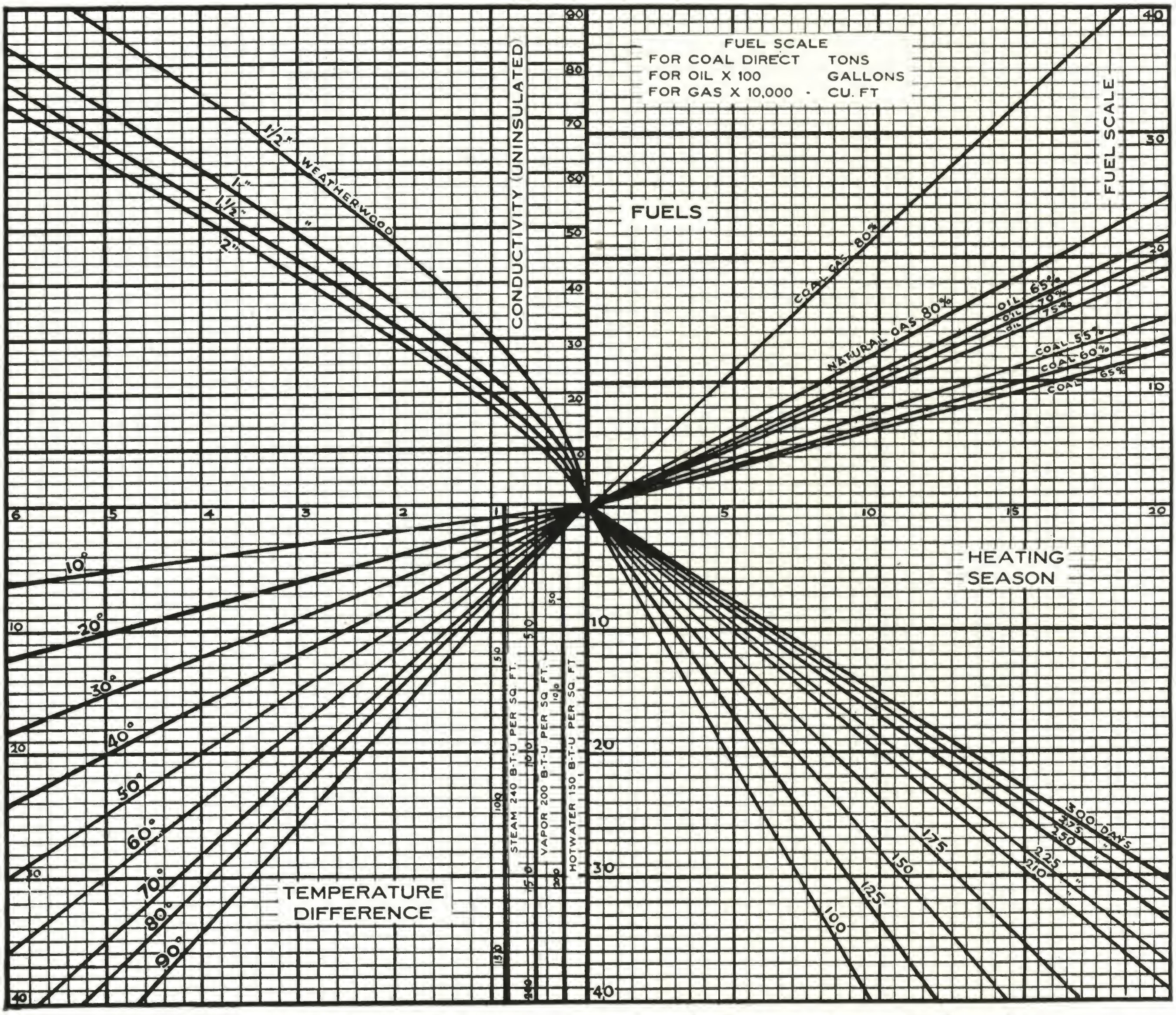
CHART FOR GRAPHIC SOLUTION OF FUEL AND RADIATION PROBLEMS



RELATIVE HUMIDITY—Degrees Wet-bulb Depressions—Fahrenheit

Dry-Bulb Temp. F.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
50	93	87	80	74	67	61	55	49	43	38	32	27	21	16	10	5																
52	94	87	81	75	69	63	57	51	46	40	35	29	24	19	14	9	4															
54	94	88	82	76	70	64	59	53	48	42	37	32	27	22	17	12	8	3														
56	94	88	82	76	71	65	60	55	50	44	39	34	30	25	20	16	11	7														
58	94	88	83	77	72	66	61	56	51	46	41	37	32	27	23	18	14	10														
59	94	89	83	78	72	67	62	57	52	47	42	38	33	29	24	20	16	11														
60	94	89	83	78	73	68	63	58	53	48	43	39	34	30	26	21	17	13														
61	94	89	84	78	73	68	63	58	53	49	44	40	35	31	27	22	18	14														
62	94	89	84	79	74	69	64	59	54	50	45	41	36	32	28	24	20	16														
63	95	89	84	79	74	69	64	60	55	51	46	42	37	33	29	25	21	17														
64	95	90	84	79	75	70	65	60	56	51	47	43	38	34	30	26	22	18														
65	95	90	85	80	75	70	66	61	57	52	48	44	39	35	31	27	24	20														
66	95	90	85	80	75	71	66	61	57	53	48	44	40	36	32	29	25	21														
67	95	90	85	80	76	71	66	62	58	53	49	45	41	37	33	30	26	22														
68	95	90	85	80	76	71	67	62	58	54	50	46	42	38	34	31	27	23														
69	95	90	85	81	77	72	67	63	59	55	51	47	43	39	35	32	28	24														
70	95	90	86	81	77	72	68	64	59	55	51	48	44	40	36	33	29	25														
71	95	90	86	81	77	72	68	64	60	56	52	48	45	41	37	33	30	27														
72	95	91	86	82	77	73	69	65	61	57	53	49	45	42	38	34	31	28														
73	95	91	86	82	78	73	69	65	61	57	53	50	46	42	39	35	32	29														
74	95	91	86	82	78	74	69	65	61	58	54	50	47	43	39	36	33	29	26	23	20	17	14	11								
75	96	91	86	82	78	74	70	66	62	58	54	51	47	44	40	37	34	30	27	24	21	18	15	12	9	7	4	1				
76	96	91	87	82	78	74	70	66	62	59	55	51	48	44	41	38	34	31	28	25	22	19	16	13	11	8	5	3				
77	96	91	87	83	79	74	71	67	63	59	56	52	48	45	42	39	35	32	29	26	23	20	17	14	12	9	6	4				
78	96	91	87	83	79	75	71	67	63	60	56	53	49	46	43	39	36	33	30	27	24	21	18	16	13	10	8	5	3			
79	96	91	87	83	79	75	71	68	64	60	57	53	50	46	43	40	37	34	31	28	25	22	19	17	14	11	9	6	4	1		
80	96	91	87	83	79	75	72	68	64	61	57	54	50	47	44	41	38	35	32	29	26	23	20	18	15	12	10	7	5	3		
81	96	92	88	84	80	76	72	69	65	61	58	55	51	48	45	42	39	36	33	30	27	24	21	19	16	13	11	9	6	4		
82	96	92	88	84	80	76	72	69	65	61	58	55	51	48	45	42	39	36	33	30	28	25	22	20	17	14	12	10	7	5		
83	96	92	88	84	80	76	73	69	66	62	59	56	52	49	46	43	40	37	34	31	29	26	23	21	18	15	13	11	8	6	3	2
84	96	92	88	84	80	76	73	69	66	62	59	56	52	49	46	43	40	37	35	32	29	26	24	21	19	16	14	12	9	7	5	3
85	96	92	88	84	81	77	73	70	66	63	60	57	53	50	47	44	41	38	36	33	30	27	25	22	20	17	15	13	10	8	6	4
86	96	92	88	84	81	77	73	70	66	63	60	57	53	50	47	44	42	39	36	33	31	28	26	23	21	18	16	14	11	9	7	5
87	96	92	88	85	81	77	74	70	67	64	61	57	54	51	48	46	43	40	37	34	32	29	26	24	22	19	17	15	12	10	8	6
88	96	92	88	85	81	77	74	70	67	64	61	57	54	51	48	46	43	40	37	35	32	30	27	25	22	20	18	15	13	11	9	7
89	96	92	88	85	81	78	74	71	68	65	61	58	55	52	49	47	44	41	38	36	33	31	28	26	23	21	19	16	14	12	10	8
90	96	92	89	85	81	78	74	71	68	65	61	58	55	52	49	47	44	41	39	36	34	31	29	26	24	22	19	17	15	13	11	9
92	96	92	89	85	82	78	75	72	68	65	62	59	56	53	50	48	45	42	40	37	35	32	30	28	25	23	21	19	17	15	13	11
94	96	93	89	85	82	79	75	72	69	66	63	60	57	54	51	49	46	43	41	38	36	33	31	29	27	24	22	20	18	16	14	12
96	96	93	89	86	82	79	76	73	69	66	63	61	58	55	52	50	47	44	42	39	37	35	32	30	28	26	24	22	20	18	16	14
98	96	93	89	86	83	79	76	73	70	67	64	61	58	56	53	50	48	45	43	40	38	36	34	32	29	27	25	23	21	19	17	15
100	96	93	89	86	83	80	77	73	70	68	65	62	59	56	54	51	49	46	44	41	39	37	35	33	30	28	26	24	22	21	19	17
104	97	93	90	87	83	80	77	74	71	69	66	63	60	58	55	53	50	48	46	43	41	39	37	35	33	31	29	27	25	23	21	20
108	97	93	90	87	84	81	78	75	72	70	67	64	62	59	57	54	52	49	47	45	43	41	39	37	35	33	31	29	27	25	24	22
112	97	94	90	87	84	81	79	76	73	70	68	65	63	60	58	55	53	51	49	47	44	42	40	38	36	35	33	31	29	27	26	24
116	97	94	91	88	85	82	79	76	74	71	69	66	64	61	59	57	54	52	50	48	46	44	42	40	38	36	34	33	31	29	28	26
120	97	94	91	88	85	82	80	77	74	72	69	67	65	62	60	58	55	53	51	49	47	45	43	41	40	38	36	34	33	31	29	28

Note: Figures horizontally opposite the dry-bulb reading and vertically opposite the wet-bulb reading give the percentage of relative humidity.

Continued on next page

(L10) PREVENTION OF CONDENSATION

(L10a) General

The condensation of moisture is an every day phenomenon causing more or less unsatisfactory conditions wherever it is not properly controlled. The control of condensation in industrial plants, where working conditions involve high moisture content of the air, is an important item in plant maintenance and employee health. In some types of plants, such as laundries, paper mills and bakeries, this is a necessary evil which can be eliminated only by great expense. In other types of industrial buildings such as textile mills or tobacco plants, a high moisture content of the air is absolutely essential to provide proper working and conditioning factors. Modern buildings are providing humidity control in order to maintain the higher relative humidity of the air required to promote comfort and health of occupants. These conditions require proper insulation against heat loss through the roof in order to prevent the condensation of moisture on these surfaces, which not only impairs the mechanical efficiency of the humidity control, but makes working conditions unsatisfactory, and adds unnecessary hazards to delicate equipment or material in process of manufacture.

It is common knowledge that condensation of moisture, that is, the forming of minute particles or drops of moisture upon a surface is caused by warm, moist air striking a colder surface and in so doing, precipitates the moisture content on the cold surface. The fundamental reason for this lies in the ability of air to hold only a certain quantity of moisture vapor in suspension at certain temperatures. Air at 100 degrees Fahrenheit is capable of holding more moisture vapor in suspension than air at 75 degrees Fahrenheit. In this respect, air may be compared to a sponge, which when fully expanded is capable of holding a great deal more water than when it is partially contracted or squeezed. The cooling of air is comparable to the squeezing of the sponge. When air strikes a cold surface and is suddenly cooled, it is obvious that being unable to hold the water vapor in suspension, this water vapor is condensed into the form of moisture or drops of water which naturally form on the surface which has cooled the air.

Obviously, the preventive for condensation lies in maintaining a surface warm enough so that it does not sufficiently cool the surrounding air to cause a depositing of moisture. Two general methods of providing proper temperatures of surfaces are possible—first, a high velocity of warm air played upon the colder surface will break down the surface film of still air lying directly over the surface of the material and so warm the surface that condensation cannot take place. This method is extremely expensive and in most cases impractical. In stores, fans are oftentimes placed so as to play upon the show window glass area and are sufficient to keep the temperature of the inside glass surface above the condensation point. The second method, and more practical one, is the proper insulation of the ceiling from exterior cold conditions so that the temperature drop from interior ceiling to interior air is not sufficient to bring the air to the point at which condensation will take place.

The insulation of ceiling surfaces to prevent condensation should be accomplished by the application of Weatherwood Roof Insulation on the exterior or coldest surface of the roof. This is always advisable since the mass of roof structure is thus kept at a warmer temperature. Insulation against condensation is the reverse of insulating against heat loss, as regards the effective location of the insulating material. It is best to eliminate as much volume to be heated as possible when insulating to conserve heat. In the case of condensation, it is desirable to keep the mass of roof structure as warm as possible, to give added insurance against condensation. This is particularly true in frame construction as warm, moist air is liable to filter in behind the insulation, developing condensation on the interior of the wall structure. It is true in a lesser extent with masonry construction, as warm, moist air may find its way into crevices of the masonry.

The problem of preventing condensation then, resolves itself into providing sufficient insulation to maintain proper interior temperature of wall or ceiling surfaces. The amount of insulating material required is governed by the relative humidity of the air inside and the range of exterior temperatures. For the convenience of those interested in the prevention of condensation, a chart is reproduced on page 23 giving an easy and quick method of determining the proper amount of Weatherwood required to offset various conditions.

The determination of the amount of insulation required to prevent condensation under any specified condition is a simple mathematical computation. It is necessary, however, to understand clearly the factors involved in the computation.

(L10b) Factors Involved

(L10b1) Relative Humidity—This is the first and prime factor to be given consideration in any condensation problem, because the relative humidity may or may not be changed in order to improve conditions. As stated in (L10a), the humidity in an industrial structure sometimes is an unnecessary evil in which case it can be reduced somewhat by mechanical means or it may be an absolute necessity to provide proper working conditions. In any event, the humidity at which the structure will be used must be determined and this value used in the computation for required amount of insulation.

Humidity is defined as the number of pounds of water carried as vapor by one pound of dry air. This definition refers strictly to water and air, as we are working with these mediums. Humidity is also used to denote the same relationship between any liquid vapor and dry gas. This relationship is often called absolute humidity.

In the condensation problems we are primarily concerned with relative humidity. This is defined as the ratio between the amount of water vapor contained in the air at any given temperature to the amount of water vapor the same air would carry or hold at the same temperature if the air were saturated. That is, relative humidity is really an expression of the percentage of saturation existing in the air under any given condition. Exterior air is always partially saturated with moisture and a study of weather bureau reports shows that the humidity of the exterior air varies from hour to hour during the day. The average humidity for various parts of the United States taken at 8 A.M. ranges between 70% and 85%, while the average humidity for the same locality at 8 P.M. ranges between 50% and 75%. The reason for this lies in the heavy condensation of moisture on the earth's surface during the early hours of the morning with the resultant higher saturation of the lower strata of air during the early hours. As the sun and wind distribute this moisture, however, through the entire atmosphere and also as the air is warmed and expands, the relative percentage of saturation is reduced.

Condensation problems are not concerned with exterior humidity conditions. The air within a structure may be entirely different as to percentage of saturation compared to exterior air. This percentage of saturation depends directly upon the processes of manufacture and the artificial humidity control provided within the structure. The following list of industrial plants indicates some of the types of plants in which condensation problems will be found and also gives the usual prevailing relative humidity for such plants.

Type of Building	Average Relative Humidity
Laundries	66% to 88%
Dry cleaning plants	65% to 85%
Paper mill roofs	70% to 85%
Paper machine hoods	85% to 95%
Textile Mills	65% to 85%
Bakeries	80% to 90%
Canning factories	70% to 85%
Ripening and seasoning rooms	80% to 90%

If it is impossible to make a check of humidity conditions, or for buildings under design, a relative humidity should be figured at about the maximum of the usual conditions as indicated by the above table. However, it is always advisable to make a check test to determine the relative humidity either on the structure under consideration or on a similar one.

This test is simply a matter of obtaining dry-bulb and wet-bulb readings within the room. The dry-bulb reading is the ordinary thermometer temperature. This temperature should, however, be taken at a point as near the surface on which the condensation forms as possible. The wet-bulb reading merely means that the bulb of the thermometer is wrapped in a cloth

Continued on next page

or any material which will hold moisture so that the evaporation of this moisture affects the temperature reading of the thermometer. A simple method of obtaining this wet-bulb reading is to use an ordinary thermometer which has a cloth wrapped around the mercury bulb at the bottom. This cloth should be dipped in water at a temperature as near room temperature as possible. After thoroughly wetting the cloth, the thermometer itself should be whirled around in the air, either with the hand or on the end of a cord, so that the maximum evaporation effect can take place. Several such trials should be made until the lowest reading is obtained by this method. The difference between the wet-bulb and the dry-bulb reading is known as the wet-bulb depression. By referring this wet-bulb depression to table on page 20, the relative humidity of the air can be determined.

(L10b2) Temperature Conditions—Next determine the maximum temperature difference between the interior temperature and the coldest outside temperature at which it is ncessary to prevent condensation. If it is desired to prevent condensation even on the very coldest days take the lowest outside temperature for the locality from weather bureau reports given in the table on page 19.

If it is necessary to prevent condensation only on the average cold days and a very slight amount of condensation would be permissible on the extreme cold days, a temperature of 15 or 20 degrees above the lowest recorded temperature should be used. The difference between the inside temperature and this temperature is the figure to be used in the computation.

(L10b3) Heat Resistance of Surface at which Condensation Takes Place—As stated in (L10a) page 21, condensation is due to the cooling of the interior air as it strikes the ceiling or under side of roof deck, which is colder. This difference in temperature is due to the heat resistance of the surface, that is, the thin film of air which forms next to the surface and is stationary. This resistance will vary with different types of surfaces, and as it is the drop in temperature across this surface resistance that causes condensation, the accurate value for the type of surface used must be obtained for the computation. The following is a table of surface conductivities as determined by Harding and Willard, taken from the Heating and Ventilating Engineer's Guide.

Building Material	**Surface Coefficient**
Asbestos (sheet)	1.40
Brick work (ordinary)	1.40
Cement plaster (finished)	0.93
Concrete	1.30
Cork Board	1.25
Glass	1.50
Wood (finished surface)	1.40
Average of all values	1.34

The values quoted in the above table are given in B.t.u. per square foot of surface, per hour, per degree Fahrenheit difference in temperature. The average value of 1.34 is often used in computation in preference to a specific value for a definite material, particularly where no values are known for the material in use. Where surfaces are used, which are known to be much higher or lower than the average value, these definite values should always be used.

(L10b4) Determination of Dew Point—Condensation is caused by a cooling of the air to the point at which the air is totally saturated with moisture. For example, air at 60° F. and with a humidity of 90% will reach saturation, if cooled 3° and condensation will begin. The allowable drop in temperature which will not bring saturation under any conditions of relative humidity and temperature, must now be determined by use of chart at bottom of page 23 as follows: Select the temperature along the bottom of the chart corresponding to the condition in the structure. Follow vertically upward on this line until an intersection is made with the horizontal line representing the humidity within the structure. From this point, follow the curved lines up to the top of the chart. Along the top of the chart is a second temperature scale. The point on this scale intersected by the curved line is the dew point temperature. Subtracting this temperature from the original temperature gives the drop in temperature which will cause condensation. This drop in temperature is to be used in the computation of thickness of insulation required.

(L10b5) Conductivity of Roof Deck Uninsulated—The final factor in making computation for the prevention of condensation is the heat conductivity of the roof deck uninsulated. These values may be obtained by referring to table on page 18 and selecting the type of structure to be used.

(L10c) MATHEMATICAL COMPUTATION OF CONDENSATION CONDITIONS

Having definitely determined all of the factors which influence the results, these factors must be arranged in mathematical order for the final computation.

The computation is as follows: First, compute the resistance of deck complete, without the insulation. This resistance is obtained by dividing the rated conductivity into one—that is: $\frac{1}{\text{B.t.u. Rating}}$ = Resistance. Now divide the total temperature difference by the conductivity of the surface film and divide again by the drop in temperature which will cause condensation of the moisture in the air. From this product subtract the resistance of the deck and multiply the difference by the conductivity of Weatherwood per inch of thickness (or .32). This gives the actual thickness of Weatherwood which will just prevent condensation under the condition stated.

Example

Same general conditions assumed as for typical analysis for fuel saving in (L9c) page 17.

Inside temperature (operating condition)	65° F.
Outside temperature—low	–8° F.
Temperature difference	73°
Relative humidity (near roof)	70%
Conductivity of deck uninsulated	.532
Surface conductivity (using average value)	1.34
Temperature drop across surface that will cause condensation (from chart at the bottom of page 23)	10.5°

$$\text{Resistance of deck uninsulated} = \frac{1}{.532} = 1.88$$

$$\left\{\frac{73}{1.34 \times 10.5} - 1.88\right\} \times .32 = 1.05''$$

One inch of Weatherwood is sufficiently close to eliminate any condensation except on days with temperature below —8° F.

(L10d) GRAPHIC SOLUTION OF CONDENSATION PROBLEMS

The chart at the top of page 23 provides a quick and easy method of computing the amount of insulation required. This eliminates the necessity of mathematical computation and the necessity of referring to the psychometric chart to determine the temperature drop permissible, so that a complete solution is provided in one operation. This is done as follows: Select on the inside temperature scale at the upper left edge of the vertical center line the temperature for the building in question. From this point, pass horizontally to the left to an intersection with the line representing the relative humidity. From this point, pass vertically down to the diagonal line representing the temperature difference (inside maximum and outside low). From this point, pass horizontally over to the diagonal line representing surface coefficient. From this intersection, pass vertically up until an intersection is made with the horizontal line representing conductivity of uninsulated deck. If this intersection point falls close to one of the Weatherwood lines, the thickness represented by the line will prevent condensation. If the intersection falls between Weatherwood lines, the next line representing the next greater thickness is the amount of Weatherwood necessary.

It is obvious that a complete reversal of the method can be used to determine the relative humidity a certain deck and certain amount of insulation will support. For an uninsulated deck start at the conductivity of the deck located on the horizontal scale at the center of the chart.

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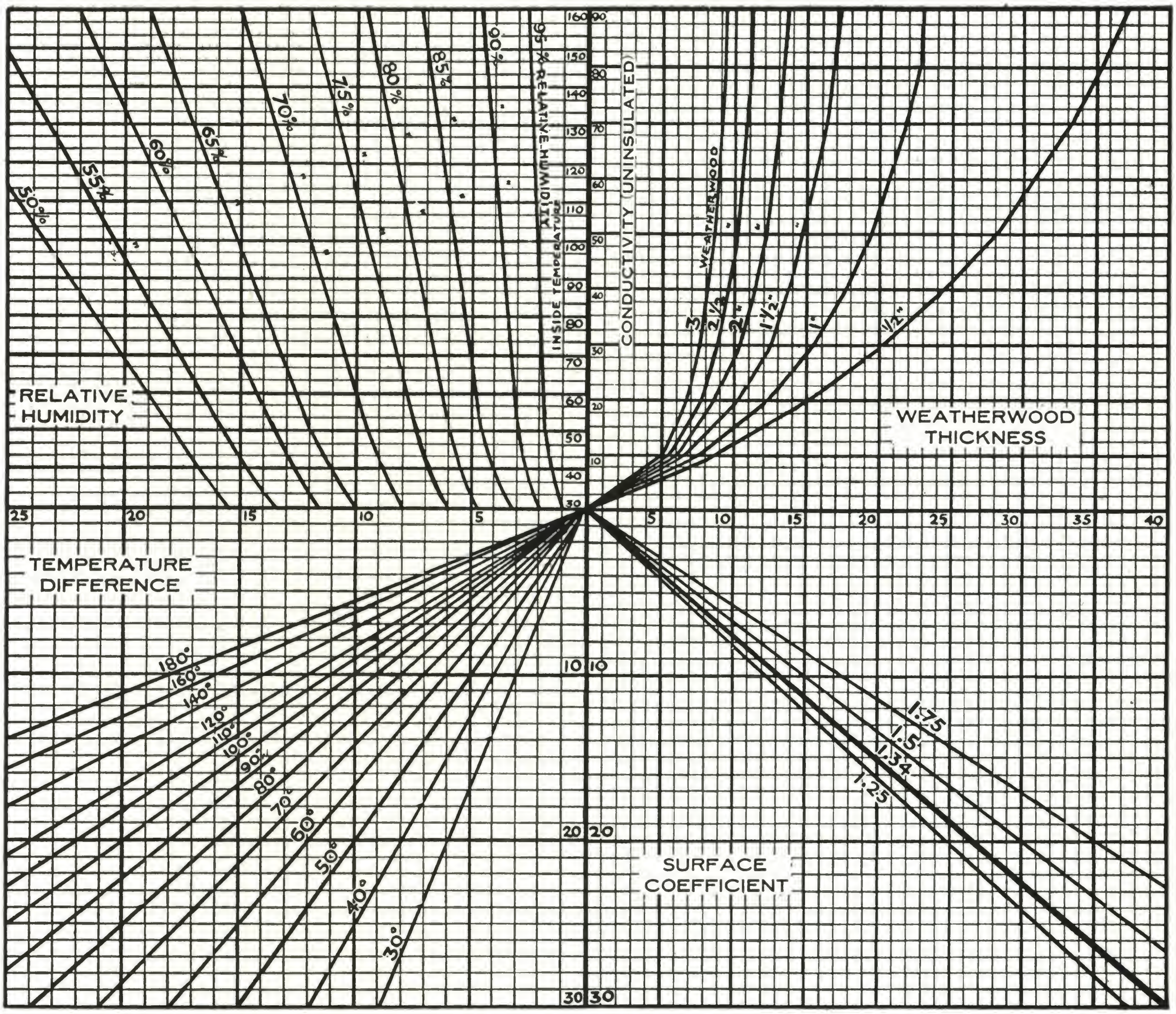
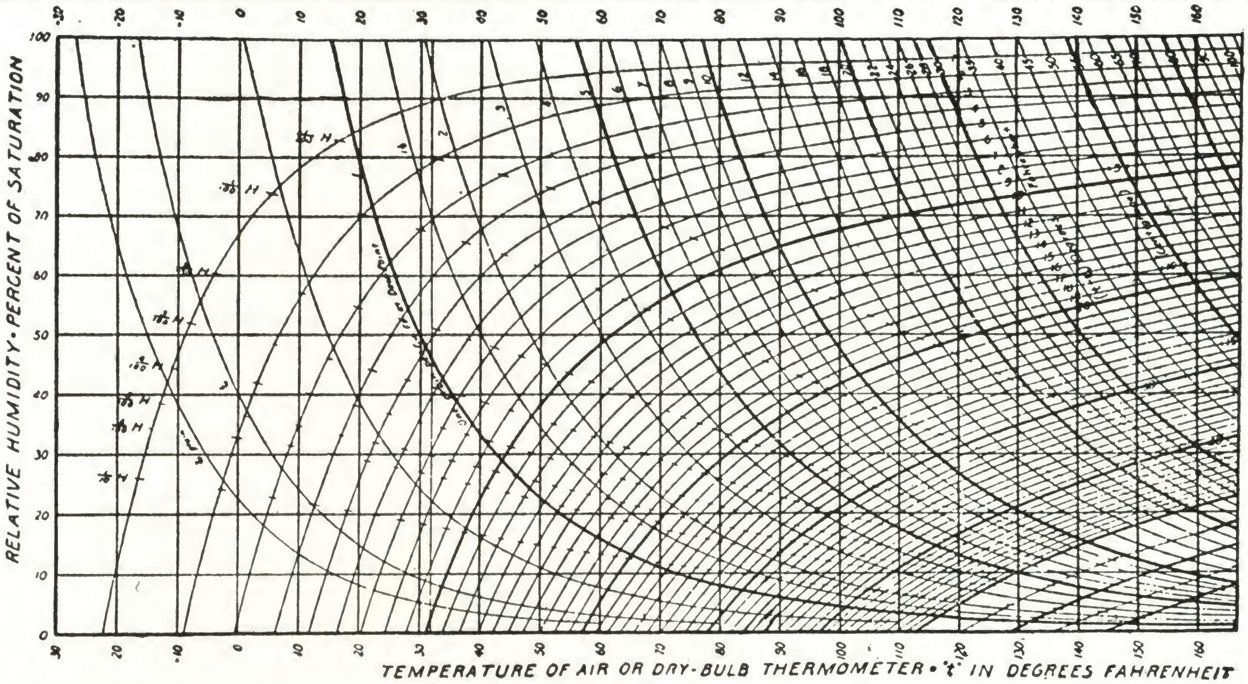
CHARTS FOR GRAPHIC SOLUTION OF CONDENSATION PROBLEMS





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(M) WEATHERWOOD SOUND DEADENING CONSTRUCTION

(M1) The Need for Sound Deadening

Although much stress has been laid upon the strength and fire resistance of buildings, and within later years, upon the insulation of buildings to stop heat loss, very little attention has been paid to the importance of insulating against sound passing between adjoining rooms or apartments.

It is only too true that in many apartment buildings today, ordinary conversation in one apartment can be heard in adjoining apartments. Consider then, how much more disturbing it must be when there are noises in one apartment which are considerably louder than the ordinary spoken tone. What is true in apartment buildings is equally true in offices and industrial buildings. Laboratory research shows that noise reduces personal efficiency from five to thirty per cent, depending upon the occupation of those affected.

Dr. Donald A. Laird, Director of the Psychological Laboratory of Colgate University, says, "Many executives think that noise is inevitable, that nothing can be done to lessen it, and that any way it does not matter. All three ideas are wrong. Noise cuts into dividends by lessening output and requiring more energy from workers. There is no evidence that workers get used to noise. They may become unconscious of its presence, but the effect upon their output remains.

"In the Colgate University Laboratory, it was determined by the use of special apparatus that noise of usual office intensity cuts into the output of professional typists on the average of 5 per cent. In higher mental work, such as the executive does, the cut into output is in the neighborhood of 30 per cent.

"In a survey of two large plants conducted by the United States Public Health Service, it was found that labor turnover, absence from work, and requests for transfer to other work were above the plant average in those departments which were noisy."

Owners and operators of apartment buildings and apartment hotels are today finding that effective sound deadening between rooms or apartments is an important factor in leasing and filling these buildings. In many cases apartments have been rented on the supposition that they were soundproof, because of the fact that they were built along heavy construction lines. Later, occupants have found, to their sorrow, that this did not solve the problem and that they were much disturbed by occupants of adjacent apartments.

There are many points at which sound deadening is necessary. These points include the transmission of sound between offices, apartments or studios; transmission of sound between reception rooms and consultation rooms; transmission of sound between floors; transmission of sound between rooms and adjacent elevator shafts; transmission of sound from mechanical and ventilating equipment; transmission of sound between manufacturing and office space in industrial buildings; transmission of sound between kitchens or equipment rooms and patients' rooms of hospitals.

The purpose of this Division is to give briefly the important facts to be considered on the subject of sound deadening.

Definite suggestions are made as to various methods of obtaining sound deadening of wall or floor sections, and diagrams indicate the construction suggested.

Scientists agree that a material which in itself will absorb a certain amount of sound and can be used in a structural way, is well adapted for use in sound deadening construction. This is quite true of Weatherwood, an insulating board fabricated from hardwood. The Manufacturing Process (A) pages 1 and 2 and the Physical Characteristics (B) pages 2, 3 and 4 clearly indicate why Weatherwood is readily adaptable for sound insulation, as well as for heat insulation.

(M2) The Problem of Sound Deadening

The general problem of insulation or isolation of sound does not differ greatly from the problems encountered in the insulation of heat. In both cases is is a form of energy that is being dealt with and, in both cases, it is an economic impossibility to prevent entirely the transmission of such energy. Modern demand for higher standards of living are just beginning to be felt in the sound deadening field. Sound filters through loose and flimsy construction just as heat filters through. Consequently, the problem of sound insulation ultimately resolves itself into the same thorough attention to detail as is necessary where efficient heat insulation is required.

It so happens that the same characteristics which make certain materials good heat insulators, make them peculiarly adaptable and efficient in the insulation of sound. The following data outlines briefly how sound is insulated or isolated and at the same time shows clearly why Weatherwood provides good sound deadening results and how it should be employed to do so.

(M3) Sound Transmission

The insulation of sound really divides itself into two separate problems based on the origin of the sound. There are two distinct types of sound. First, those sounds which originate in or are produced first in air; second, impact or tapping sounds, such as sounds produced when a solid wall or metal pipe is struck by a hard object. The transmission of both of these types of sound takes place through all physical mediums, no physical substance being entirely resistant to sound transmission. One kind of sound insulation, however, will not produce equal results with both types of sound and different methods must be employed when insulation for both types is required.

Sound is transmitted first by conduction, and second, by vibration of solid bodies or areas. The conduction of sound is effected by the transfer of sound energy from particle to particle of any substance and in the case of many materials, with only a little loss of original intensity. This phenomena of sound transmission is similar in results to the transmission of heat energy, or for that matter any form of energy transfer by conduction. In the case of sound energy, a vibration is set up in the particle immediately adjacent to the source of sound and this vibration is reproduced in each succeeding particle in contact. Different materials have different rates or velocities at which the transmission of sound through them will take place. Generally speaking, those materials with low velocity of sound transfer are better for sound insulation. As in the case of heat transfer, air and other gases have a comparatively lower transfer rate than solids, such as wood or steel. The following brief table is indicative of the nature of transmission of sound by conduction through materials.

VELOCITIES OF SOUND (Approximate Values)

Substance	Velocity in feet per second	Reported
Aluminum	16,740	Masson
Copper	11,670	Wertheim
Gold—soft	5,717	Wertheim
Iron	16,320	Wertheim
Lead	4,026	Wertheim
Zinc	12,140	Wertheim
Vulcanized rubber	177	Exner
Pine—along the fiber	10,900	Wertheim
Poplar—along the fiber	14,050	Wertheim
Brick	11,980	Chladni
Air—dry	1,087	Violle
Illuminating gas	1,609	Zoch
Water	1,315	Masson

The second method of sound transmission is by means of vibrating bodies or areas. This type of sound transmission is illustrated by the use of sounding boards. In this type of transmission, the sound may either originate as an air borne or an impact sound, but results in the setting up of vibrations of an entire area or panel, the original sound having set this panel into vibration. The vibration of the panel itself reproduces and transmits the original sound into the next medium by its vibration. A body having a large area as compared to volume has a marked tendency to transmit sound by vibration, as compared to those bodies having a large volume and small areas. Thin bodies have a tendency to increase their vibration effect as the area increases. Thin, vibrating panels vary in transmission of sound in proportion as their total area is increased and also as the rigidity of the fastening of the edges is lessened. In other words, rigid fixing of the edges of thin panels, aids in preventing the transmission ot sound through such a panel.

After consideration of the methods by which sound is transmitted, it is obvious that the chief difference between air borne sound and impact sound, as regards their insulation, lies chiefly in the comparative intensities of such sound. In other words, air borne sounds have had the deadening and what is more important, the diffusing influence of the volume of air in which they originated, while the impact sounds are transmitted practically in their initial intensity with none of the reducing effects of diffusion in surrounding media or

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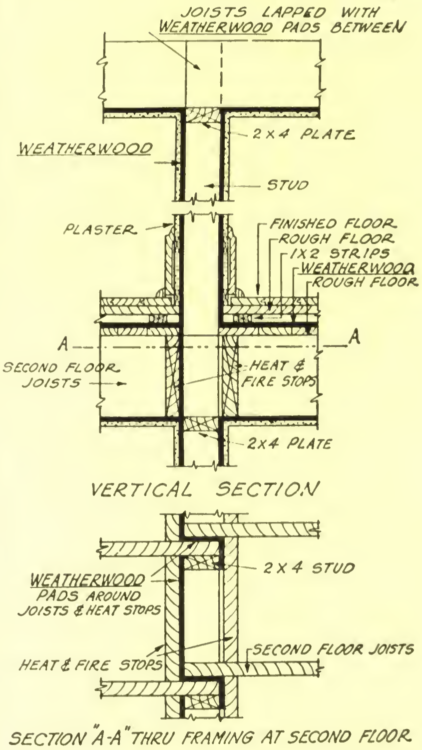
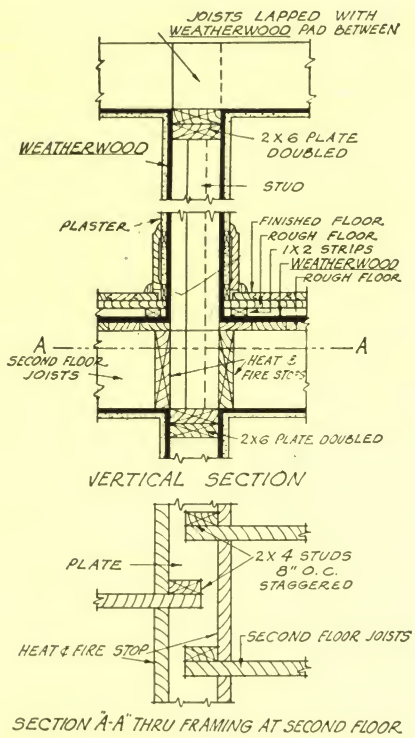
deadening by passing through low velocity material. It is obvious from this that air borne sounds having an intensity exactly equal to impact sound, as they both strike a transmitting medium or material, would require very much the same insulation design for proper deadening. However, this is very rarely the case, and air borne sounds reach the separating wall, floor, or structure, usually at a greatly reduced intensity as compared to the intensity of impact sounds. Generally speaking, then, it is obvious that impact sounds will be found to be much more difficult to insulate than those which are air borne. For that reason sound deadening construction is particularly valuable in apartment buildings, hotels, hospitals, public buildings and industrial buildings.

(M4) Destruction of Sound Energy

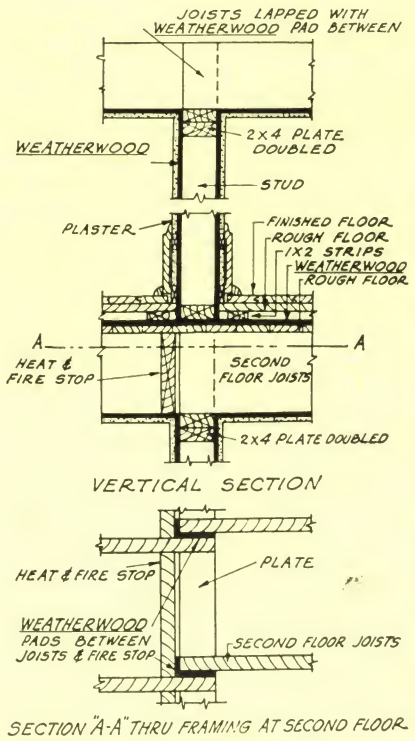
Sound is a form of energy and the fundamental physical laws tell us that energy is never destroyed, but is merely stored in one form or another. The destruction, therefore, of sound energy involves a change into some other form. In other words, sound is capable of doing work and the performance of this work must be permitted in such a way that the original sound is dissipated or transformed into heat to the greatest possible extent, thus preventing the transmission of the original sound into those spaces which are to be insulated. Those materials which have a low velocity rate for the transmission of sound obviously assure greater dissipation of sound. This greater resistance may be compared to electrical resistance, that is, the resistance built up by low transmission rate materials transforms more of the original sound into heat thus changing its original form. The destruction, therefore, of sound energy requires the use of "dead" or low transmission rate materials in the arrangement of materials through which the sound must pass. It is at the same time obvious that if comparatively "dead" materials are used in large, thin, section areas, a tendency to transmission by vibration is created. A combination structure must, therefore, be provided, which gives in the first place rigidity, to prevent transmission by vibration and in the second place, involves the use of a "dead" material to assist in the destruction of sound energy. A complete treatise, "The Weatherwood Handbook of Sound Deadening Construction" will be sent on request to anyone interested.



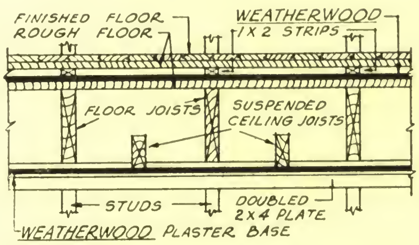
STRAIGHT STUD PARTITION
Balloon Frame



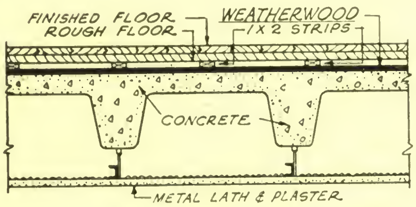
STAGGERED PARTITION



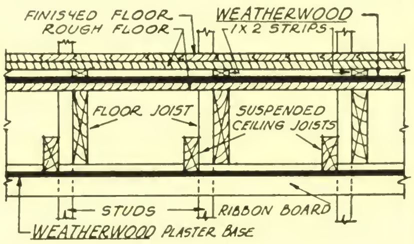
STRAIGHT STUD PARTITION
Western Frame



SUSPENDED CEILING
Balloon Construction



SUSPENDED CEILING
Concrete Slab



SUSPENDED CEILING
Platform Construction

SOUND DEADENING CONSTRUCTION DETAILS

Weatherwood
Insulation Data Book
for
Architects

INSULATION DIVISION

CHICAGO MILL AND LUMBER CORPORATION
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